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1AC – Inherency

Observation One: Inherency (Too Much Junk in the Trunk)

a. Space debris is increasing rapidly in the status quo – absent new action, the cascade effect will make space permanently unusable.

Imburgia ’11 (Joseph, Lieutenant Colonel in the US Army, Judge Advocate for the USAF, “Space Debris and Its Threat to National Security: A Proposal for a Binding International Agreement to Clean Up the Junk,” Vanderbilt Journal of Transnational Law, Volume 44, Number 3, May)

The “cascade effect” is “the greatest fear of those who study the problem of orbital debris.”50 Even before the February 2009 satellite collision, many scientists agreed “that the number of objects in orbit had surpassed a critical mass,”51 the point at which “orbital debris would collide with other space objects, which in turn would create new debris that would cause [a chain reaction of] even more collisions.”52 This “chain reaction” is often referred to as the cascade effect.53 Some experts believe that once space debris collisions begin, they will be impossible to stop.54 The fear is that these cascading “collisions will eventually produce an impenetrable cloud of fragmentation debris that will encase Earth[, making] space travel . . . ‘a thing of the past’ and . . . obstruct[ing] our dream of colonizing outer space.”55 Experts warn that if the cascade effect occurs, space will be unusable for centuries due to the time it will take for all of the debris to eventually disintegrate in Earth’s atmosphere.56 If space debris is not immediately countered by preventative and removal measures, the cascade effect could occur in little more than a decade.57 In February 2008, Dr. Geoffrey Forden, a Massachusetts Institute of Technology physicist and space programs expert, stated that the United States is “in danger of a runaway escalation of space debris.”58 He argued that the danger of a cascade effect is a greater threat to U.S. space assets than the threat of anti-satellite (ASAT) weapons.59 NASA scientists have warned about the threat of the cascade effect since the late 1970s.60 In the decades since, experts have worried that collisions caused by the cascade effect “would expand for centuries, spreading chaos through the heavens”61 and multiplying space “debris to levels threatening sustainable space access.”62 “Today, next year or next decade, some piece of whirling debris will start the cascade, experts say.”63 According to Nicholas L. Johnson, NASA’s chief scientist for orbital debris, the cascade is now “inevitable” unless something is done to remove the debris.64 Experts believe that if nothing is done to address the space debris problem, the amount of orbiting space debris greater than ten centimeters in size will increase to over 50,000 objects in the next fifty years.65 Considering that the number of objects in orbit has increased drastically since the beginning of 2007, the problem is, unfortunately, only worsening.

b. Current efforts are just focusing on tracking and even that funding is being cut.

Smith, ’11 (Marcia, Secure World Foundation, “Space Debris in LEO Continues to Increase,” 24 June 2011

<http://spacepolicyonline.com/pages/index.php?option=com_content&view=article&id=1646:space-debris-in-leo-continues-to-increase&catid=75:news&Itemid=68>

The first trend pointed out in the report is that the amount of debris in low Earth orbit (LEO) continued to increase during the past year (2010). Debris from China's 2007 antisatellite (ASAT) test against one of its own satellites has surpassed 3,000 objects according to the report. Some of the increase can be attributed to discovery of additional debris from the test itself, but some is also caused by debris impacting other debris and creating more of it. Even though there is more awareness of the problem, "space debris continues to pose an **increasing threat** to operational satellites and the long-term sustainability of space activities," says the report. The report also notes that the U.S. Department of Defense (DOD) is adding to its capabilities to track and catalog such objects in Earth orbit through space situational awareness (SSA) activities such as plans to build a new Space Fence of ground-based radars. Information in the report is current through the end of 2010. More recently, the House Appropriations Committee recommended **significant cuts** to the proposed Space Fence and other DOD SSA plans in the defense appropriations bill (H.R. 2219).

1AC – Harms 1/

Observation Two: Significant Harms & Advantages

a. There are over 500,000 untraceable pieces of space debris.

Baiocchi, '10 (Dave, William Welser IV, "Confronting Space Debris” RAND, National Defense Research Council, Prepared for the Defense Advanced Research Projects Agency Approved for public release, rand.org)

This risk poses a threat to the United States’ ability to access and use the space environment. For example, on the most recent Hubble Space Telescope repair mission in May 2009, NASA estimated that astro- nauts faced a 1-in-89 chance of being fatally injured by a piece of debris while operating on the telescope outside the space shuttle (Matthews, 2009). The United States maintains a catalog for space objects that are larger than about 10 cm in diameter, and this catalog currently contains about 20,000 objects, of which debris constitutes a majority (Kehler, 2010; Space Track, undated). In addition, NASA estimates that there are an additional 500,000 objects between 1 and 10 cm, and that there are likely tens of millions of particles smaller than a centimeter (Orbital Debris Program Office, undated). These smaller objects pose some of the greatest risk to orbiting payloads. As Johnson notes, “[T]he principal threat to space opera- tions is driven by the smaller and much more numerous uncatalogued debris” (Johnson, 2010). In LEO, objects have velocities of 7 or 8 km/s with respect to the ground, which means that even small particles can impart a tremendous amount of energy if they collide with another object. This threat is especially sobering because most small particles are uncataloged.2 Prior to 2007, the primary source of orbital debris was explosions of spent rocket engines. Originally, these engines were jettisoned in orbit after launch, and the remaining fuel expanded because of the thermal conditions. Under the right conditions, the pressure became too great, and the rocket body exploded. Since the mid-1990s, engines have been designed with valves that relieve the pressure by venting the residual fuel, and contemporary rocket bodies are no longer a major contributor of debris. To date, the largest two contributors of debris have been col- lision events. The first was the 2007 Chinese antisatellite (ASAT) test. As part of this test, China launched a ballistic missile and hit the Fengyun-1C, a defunct Chinese weather satellite. This collision event generated a debris cloud that has added 2,606 trackable objects to the U.S. space catalog as of June 2010 (Space Track, undated). In addition, some estimates suggest that between 35,000 and 500,000 smaller, untrackable pieces of debris were created as a result of this test (Carrico et al., 2008). The second event was an inadvertent collision in February 2009 between an active Iridium communications satel- lite and Cosmos 2251, a retired Russian communications satellite. This crash added 1,658 trackable objects to the U.S. catalog as of June 2010 (Space Track, undated).

b. It only takes one – A space collision would collapse the global economy, causing resource wars and the starvation of billions.

Moore, ‘9 (Mike, a research fellow with the Independent Institute and a former editor of the Bulletin of the Atomic Scientists, is the author of Twilight War: The Folly of U.S. Space Dominance, published last year by the Independent Institute. “Space Debris: From Nuisance to Nightmare, FEBRUARY 12, 2009)

End of story? Not quite. Orbital space is a natural resource, as surely as land, air, and water. It must be protected because it is home to nearly a thousand satellites put up by many countries -- communications, geo-observation, geopositioning, weather, and other kinds of satellites. Globalization would not be possible without commercial satellites. Further, the United States' military-related birds permit the country to conduct precision war. For the first time in history, satellites provide the data and the guidance necessary to enable bombs and missiles to actually hit the targets they are fired at. That's a moral plus. If a war must be fought, it should be prosecuted in such a way that military targets are hit and civilians spared to the greatest extent possible. No other country can fight a conventional war as cleanly and humanely as the United States. Satellites make the difference. Because of the importance of satellites to the American way of war, the United States insists that it must achieve the capability to militarily dominate space in a time of conflict. It is the only country that claims that right. Space, says international law on the other hand, is the common heritage of humankind and must be devoted to peaceful purposes. America's truculent space-dominance language annoys many of its friends and allies. Meanwhile, some major powers -- particularly China and Russia -- think it smells of imperialism. A country that could control space in a time of conflict might also exercise that control in a time of peace. Since 1981, virtually every country save the United States and Israel has gone on record in the U.N. General Assembly as favoring a treaty that would prevent an arms race in space. Every year, the United States -- under presidents Ronald Reagan, George H.W. Bush, Bill Clinton, and George W. Bush -- has used its veto power at the Conference on Disarmament in Geneva to prevent serious talks. No one, including the United States, is likely to have actual weapons in space in the foreseeable future. Space control does not require such weapons. Ground-based, sea-based, and even air-based antisatellite weapons (ASATs) can do the trick. The United States has long been working on a variety of highly sophisticated ASAT programs -- indeed, the infrastructure for missile defense is the sort of infrastructure needed for ASAT systems. When a country builds ever greater military capabilities, potential rivals react. China, in particular, is wary of the coercive possibilities of U.S. military power. The Middle Kingdom says it wants a space treaty, but in January 2007, it tested its own somewhat primitive ASAT -- a kinetic-kill device that roughly replicated a test the United States carried out in 1985. Is a space-related arms race under way? Yes. But there is still time to ratchet it down, and the Obama administration has signaled that it might do so. That will be difficult, though. Exceptionalism is a major driver of foreign policy, and influential people and hard-line think tanks are comfortable with the idea that full-spectrum dominance in all things military is America's right. A nightmare scenario: The United States continues to work on its defensive ASAT systems. China and Russia do the same to counter U.S. capabilities. India and Japan put together their own individual systems. Ditto for Pakistan, if it survives as a coherent country. Israel follows suit, as does Iran. In a time of high tension, someone preemptively smashes spy satellites in low-earth orbits, creating tens of thousands of metal chunks and shards. Debris-tracking systems are overwhelmed, and low-earth orbits become so cluttered with metal that new satellites cannot be safely launched. Satellites already in orbit die of old age or are killed by debris strikes. The global economy, which is greatly dependent on a variety of assets in space, collapses. The countries of the world head back to a 1950s-style way of life, but there are billions more people on the planet than in the 50s. That's a recipe for malnutrition, starvation, and wars for resources.

1AC – Harms 2/

We’ll Isolate Three Scenarios to Collisions:

1. The Economy –

Space debris threatens the global economy – every industry depends on satellites.

Brower et. el., ‘8 (Jared Brower, Stephanie Cook, Edward Dale, Josh Koch, John Miller, Stephanie Silva, All researched for the Global Innovation and Strategy Center, “Eliminating Space Debris: Applied Technology and Policy Prescriptions,” Fall 2008 – Project 07-02)

“Many objects have been jettisoned into space: lens covers, auxiliary motors, launch vehicle fairings, separation bolts used to lock fixtures in place...and objects merely dropped or discarded during manned missions.”2 That outer space exploration would create by-products is not surprising; every human venture in history has carried inefficiencies. While outer space seemed limitless a half-century ago, the Space Age has exemplified how quickly orbits around the Earth can be filled. Space debris has evolved from an environmental nuisance to a serious hazard; the U.S. space shuttle flies backwards and upside down to avoid the problem.3 With tens of millions of debris fragments flying at high velocity through lower earth orbit, both human explorers and space hardware are vulnerable. General Kevin P. Chilton, head of United States Strategic Command, recently wrote: “Military and civilian entities are heavily reliant on services that satellites provide, and space operations are so pervasive that it is impossible to imagine the U.S. functioning without them.”4 During Operation Desert Storm, commercial satellites provided 45% of all communications between the theater and the continental United States.5 Today, according to General Chilton, “We rely on satellites to verify treaty compliance, monitor threats and provide advance warning of missile attacks. It's important to remember that every soldier, sailor, Marine and airman in Iraq and Afghanistan relies on space technology for crucial advantages in the field.”6 Commercially, the **economy** of the United States is heavily dependent on space assets in **virtually every industry**. Communications, Global Positioning System (GPS) technology, agriculture, weather monitoring, and shipment tracking in the manufacturing sector are all indispensable to workings of the market.7, 8 With international economies interwoven across borders and cultures, damage to a critical satellite might pose serious monetary repercussions throughout multiple countries. For example, nearly a decade ago the failure of the Galaxy IV satellite rendered certain communications useless for two days. “The failure of that one satellite left about 80 (to) 90 percent of the 45 million pager customers in the United States without service...and 5400 of 7700 Chevron gas stations without pay-at-the-pump capability.”9 *U.S. News and World Report* recently reviewed an exercise simulating a day in the life of the U.S. military without satellites; the deputy under secretary of the Air Force for space programs was questioned about the results. “Fundamentally, you go back to fighting a war like World War II where it’s huge attrition rates, huge logistics, and huge expenses.”10 This example certainly speaks to the reliance on space assets. A lack of action to secure space assets might prove even costlier. In a knowledge-based, information-driven economy, the ability to communicate effectively and quickly is sacrosanct. *The Economist* recently painted the determination of the outcomes of future conflicts as a matter of “Brains, Not Bullets.”11 If information superiority is today’s manifest destiny, the security of space assets is not optional.

Economic collapse causes extinction.

Bearden 2000(Tom-, Retired Lieutenant-Colonel, “The Unnecessary Energy Crisis: How to Solve it Quickly,” <http://www.freerepublic.com/forum/a3aaf97f22e23.htm>)

History bears out that desperate nations take desperate actions. Prior to the final economic collapse, the stress on nations will have increased the intensity and number of their conflicts, to the point where the arsenals of weapons of mass destruction (WMD) now possessed by some 25 nations, are almost certain to be released. As an example, suppose a starving North Korea launches nuclear weapons upon Japan and South Korea, including U.S. forces there, in a spasmodic suicidal response. Or suppose a desperate China-whose long-range nuclear missiles (some) can reach the United States-attacks Taiwan. In addition to immediate responses, the mutual treaties involved in such scenarios will quickly draw other nations into the conflict, escalating it significantly. Strategic nuclear studies have shown for decades that, under such extreme stress conditions, once a few nukes are launched, adversaries and potential adversaries are then compelled to launch on perception of preparations by one's adversary. The real legacy of the MAD concept is this side of the MAD coin that is almost never discussed. Without effective defense, the only chance a nation has to survive at all is to launch immediate full-bore pre-emptive strikes and try to take out its perceived foes as rapidly and massively as possible. As the studies showed, rapid escalation to full WMD exchange occurs. Today, a great percent of the WMD arsenals that will be unleashed, are already on site within the United States itself. The resulting great Armageddon will destroy civilization as we know it, and perhaps most of the biosphere, at least for many decades.

1AC – Harms 3/

2. Blackouts –

Even small collisions hurt our GPS technology and cause blackouts.

Ansdell, ’10 (Megan, Grad Student @ George Washington University. “Active Space Debris Removal: Needs, Implications, and Recommendations for Today’s Geopolitical Environment,” [www.princeton.edu/jpia/past-issues-1/2010/Space-Debris-Removal.pdf](http://www.princeton.edu/jpia/past-issues-1/2010/Space-Debris-Removal.pdf).

There are currently hundreds of millions of space debris fragments orbiting the Earth at speeds of up to several kilometers per second. Although the majority of these fragments result from the space activities of only three countries—China, Russia, and the United States—the indiscriminate nature of orbital mechanics means that they pose a continuous threat to all assets in Earth’s orbit. There are now roughly 300,000 pieces of space debris large enough to completely destroy operating satellites upon impact (Wright 2007, 36; Johnson 2009a, 1). It is likely that space debris will become a significant problem within the next several decades. Predictive studies show that if humans do not take action to control the space debris population, an increasing number of unintentional collisions between orbiting objects will lead to the runaway growth of space debris in Earth’s orbit (Liou and Johnson 2006). This uncontrolled growth of space debris threatens the ability of satellites to deliver the services humanity has come to rely on in its day-to-day activities. For example, Global Positioning System (GPS) precision timing and navigation signals are a significant component of the modern global economy; a GPS failure could disrupt **emergency response services**, cripple global banking systems, and interrupt **electric power grids** (Logsdon 2001).

Blackouts also destabilize the grid and ensure nuclear power plant accidents.

The Public Citizen in 2003 (The Big Blackout and Amnesia in Congress: Lawmakers Turn a Blind Eye to the Danger of Nuclear Power and the Failure of Electricity Deregulation, www.publiccitizen.org/documents/bigblackout.pdf)-mikee

The blackout is a spectacular demonstration of the unreliability of nuclear reactors and the failure of deregulation. It also highlights the shocking imprudence of congressional attempts to revive nuclear power and promote more deregulation. The only things that nuclear plants can always be counted on to provide are radioactive waste and the risk of **catastrophic accidents and radioactive releases**. Nuclear plants are also an **albatross on the power grids**, by not contributing to post-blackout grid recovery, but requiring a first-priority input of electricity once the power grid has been recovered. When a blackout does occur, their **constant**, **inherent** dangers are multiplied as the plants depend on unreliable diesel generators to avoid catastrophic accidents. If backup systems should fail, it is only a matter of time before disaster strikes. If that should occur, reactor communities must contend with unreliable alarm sirens and inadequate, unfixable emergency and evacuation plans. The problems with nuclear reactors in times of **blackouts are an extremely disturbing combination**. And electricity deregulation, which precipitated the blackout, has failed in every regard. It has resulted in higher prices for ratepayers, diminished reliability and a strained transmission system caused by chaotic energy trading. Only the energy industry and its friends in Congress have benefited from the anarchy of a deregulated electricity market. The only energy crises that the United States faces have been created by electricity deregulation and a foolish refusal to e**mbrace safe, clean, sustainable energy sources**. Failure by Congress to pursue this path is utterly pathological, and it puts the American public at a greater risk of more blackouts, higher electricity rates and the danger of a serious accident at a nuclear power plant. Let us hope that this blackout serves to put Congress on alert to cast aside the monied interests and make consumers' access to energy its first priority.

1AC – Harms 4/

Another nuclear reactor meltdown would spread radiation globally; this upsets contamination conditions and leads to extinction.

Charles Hyder, who holds a Ph.D. in Astrogeophysics and worked at NASA in 2002 (Charles [holds B.S. and M.S. degrees in physics from the University of New Mexico (1958,1960), and a Ph.D. University of Colorado (1964). He has published more than twenty solar and comet papers.] “Human Extinction on this Chernobyl Contaminated Planet,” [www.members.fortunecity.com/osservatorio/charleshyderbook2.html](http://www.members.fortunecity.com/osservatorio/charleshyderbook2.html)

Overall, it is clear that unprecedented, enormous quantities of radioactivity were deposited throughout Europe, and the genetic effects will be harming the millions of contaminated people for the next 100 years. It takes about two years for atmospheric radioactivity to cross the equatorial barrier into the southern hemisphere, so in 1988 the amphibian decimations due to Chernobyl's huge radioactive releases became truly global. It will be 100 years plus before the global Cs-137 and Sr-90 radioactive contaminations return to pre-Chernobyl levels, PROVIDED no more Chernobyls recontaminate the Earth in the meantime. Chernobyl's Cs-137 and Kr-85 releases threaten Human Survival on a global scale; one or two more Chernobyls before 2015 AD would remove all doubt about Human Extinction on a global scale.…HE CONTINUES…

The final determination for the reality of a plague is morbidity and mortality figures for the exposed populations. Gould (The Enemy Within) reports "a continuing decrease in Russian life expectancy." It was 68 years before Chernobyl, but it has decreased to less than 50 years since 1996. That is the chilling radioactive reality that is ending the 20th century: The beginning of the Chernobyl-induced Russian Mass Extinctions of the 20th and the 21st centuries. Another Chernobyl before 2015, and the Russian, Byelorus and Ukraine tragedy will become global like the radioactive amphibian mass extinctions that have plagued us since Chernobyl exploded in 1986!

…HE CONCLUDES…

Thus, this genetic mechanism, characterized by "the Species Survival Equation" is the process by which "safe, low-level radiation" extinguishes and decimates lifeforms at levels of contamination that are 100x to 10,000x lower than the levels of contamination that are known to produce death within two weeks in half of the individuals exposed ("LD-50" 400 Rem; or a 400 µCi body burden in Humans, or 400 Ci/km²). These "LD-50" levels are much like the highest radioactive exposures reported in "the HOTS"-contaminated Soviet people as reported by Alla Y. and shown on her maps in black. So we not only have that long-awaited mechanism, its use allows us to interpret the Chernobyl-induced decade of global amphibian extinctions and decimations as a warning NOT to allow another Chernobyl to occur. Otherwise, the radioactive human extinctions, decimations and catastrophes being experienced now throughout the Ukraine, Byelorussia and Russia since Chernobyl would become global. Then, **Human Extinction would loom over all of us!** It is clear that planned and unplanned releases from operating nuclear reactors and from nuclear detonations will be dominated by Cs-137 and "the HOTS". Most atmospheric detonations carried the majority of their radioisotopes up into the stratosphere and then spread them downwind around the world. "The "HOTS" last about a month and spread over the 5,000 to 25,000 miles downwind (that's continental to global in scale) before they decay away.

1AC – Harms 5/

3. Global Warming

Space junk threatens critical warming monitoring satellites

Dunstan & Szoka, ‘9 (James Dunstan practices space and technology law at Garvey Schubert Barer. Berin Szoka is a Senior Fellow at The Progress & Freedom Foundation, a Director of the Space Frontier Foundation, and member of the FAA’s Commercial Space Transportation Advisory Committee. “Beware Of Space Junk: Global Warming Isn’t the Only Major Environmental Problem,” Tech Liberation Front (TLF), <http://techliberation.com/2009/12/18/beware-of-space-junk-global-warming-isnt-the-only-major-environmental-problem/>.

As world leaders meet in Copenhagen to consider drastic carbon emission restrictions that could require large-scale de-industrialization, experts gathered last week just outside Washington, D.C. to discuss another environmental problem: Space junk.[1] Unlike with climate change, there’s no difference of scientific opinion about this problem—orbital debris counts increased 13% in 2009 alone, with the catalog of tracked objects swelling to 20,000, and estimates of over 300,000 objects in total; most too small to see and all racing around the Earth at over 17,500 miles per hour. Those are speeding bullets, some the size of school buses, and all capable of knocking out a satellite or manned vehicle. At stake are much more than the $200 billion a year satellite and launch industries and jobs that depend on them. Satellites connect the remotest locations in the world; guide us down unfamiliar roads; allow Internet users to view their homes from space; discourage war by making it impossible to hide armies on another country’s borders; are utterly indispensable to American troops in the field; and play a critical role in monitoring climate change and other environmental problems. Orbital debris could block all these benefits for centuries, and prevent us from developing clean energy sources like space solar power satellites, exploring our Solar System and some day making humanity a multi-planetary civilization capable of surviving true climatic catastrophes**.**

Continued warming causes extinction.

Tickell, ‘8 (Oliver, Climate Researcher, The Gaurdian, 8-11, “On a planet 4C hotter, all we can prepare for is extinction”, [**http://www.guardian.co.uk/commentisfree/2008/aug/11/climatechange**](http://www.guardian.co.uk/commentisfree/2008/aug/11/climatechange))

We need to get prepared for four degrees of global warming, Bob Watson told the Guardian last week. At first sight this looks like wise counsel from the climate science adviser to Defra. But the idea that we could adapt to a 4C rise is absurd and dangerous. Global warming on this scale would be a catastrophe that would mean, in the immortal words that Chief Seattle probably never spoke, "the end of living and the beginning of survival" for humankind. Or perhaps the beginning of our extinction. The collapse of the polar ice caps would become inevitable, bringing long-term sea level rises of 70-80 metres. All the world's coastal plains would be lost, complete with ports, cities, transport and industrial infrastructure, and much of the world's most productive farmland. The world's geography would be transformed much as it was at the end of the last ice age, when sea levels rose by about 120 metres to create the Channel, the North Sea and Cardigan Bay out of dry land. Weather would become extreme and unpredictable, with more frequent and severe droughts, floods and hurricanes. The Earth's carrying capacity would be hugely reduced. Billions would undoubtedly die. Watson's call was supported by the government's former chief scientific adviser, Sir David King, who warned that "if we get to a four-degree rise it is quite possible that we would begin to see a runaway increase". This is a remarkable understatement. The climate system is already experiencing significant feedbacks, notably the summer melting of the Arctic sea ice. The more the ice melts, the more sunshine is absorbed by the sea, and the more the Arctic warms. And as the Arctic warms, the release of billions of tonnes of methane – a greenhouse gas 70 times stronger than carbon dioxide over 20 years – captured under melting permafrost is already under way. Many scientists warn that this historical event may be analogous to the present: the warming caused by human emissions could propel us towards a similar hothouse Earth.

1AC – Plan Text

Plan:

The United States federal government should construct ground-based lasers to remove and mitigate small space debris objects orbiting beyond the Earth’s mesosphere.

1AC – Solvency 1/

Observation Three: Solvency

a. Prevention alone is not enough – space lasers are key to solve.

Brower et. el., ‘8 (Jared Brower, Stephanie Cook, Edward Dale, Josh Koch, John Miller, Stephanie Silva, All researched for the Global Innovation and Strategy Center, “Eliminating Space Debris: Applied Technology and Policy Prescriptions,” Fall 2008 – Project 07-02)

If space debris continues to increase, the threat to space-based technology increases exponentially. Approval of space debris mitigation guidelines is a positive contribution to debris mitigation and prevention. In the short term, there is a need to clarify space terminology, define transfer-of-ownership guidelines, and create a registration timeframe to enhance the current body of space law. As is evident with the IADC, international science-focused workgroups bring together researchers from various countries with varying interests to work on a common goal. Similar initiatives promise to improve debris mitigation/elimination efforts and improve upon current elimination technologies. As the world’s dependence on space-based technology grows, an evaluation of constructs for global pooling of funds earmarked for future debris clean-up will be necessary. Prevention is the most cost effective way to keep space clean. However, prevention alone will not be enough to secure the future of space assets. The ability to remove space debris actively is imperative and there is no single solution to remove all debris sizes. Current technologies are promising, but further development remains necessary and no debris elimination technology has yet to be fully demonstrated. Ground- based lasers were found to be the most effective way to remove small debris from LEO. They are much more cost effective than adding shielding to space assets and a demonstration could prove the ability of lasers to remove smaller debris from space. Orbital rendezvous vehicles provide an example of a technology which could be used to remove large debris. The vehicles could be used to move the debris itself or used in conjunction with a drag device such as an electrodynamic tether to de-orbit debris or to place it in a graveyard orbit.

b. Large objects can be avoided and tracked – lasers are key needed for small debris.

Campbell, 2000 (Jonathan, Colonel in the United States Air Force Reserve “Using Lasers in Space”. December 2000. <http://www.nss.org/resources/library/planetarydefense/2000-LaserOrbitalDebrisRemovalAndAsteroidDeflection-Campbell.pdf>)

The use of space is vital for future economic and political power for many reasons. Since an impact from a meteorite, asteroid, or comet would he an unimaginable catastrophe, we have little choice but to deal with this threat. On a lesser scale, the threat of orbital debris to spacecraft raises important economic questions. While there are many risks with spaceflight, we must decide at what threshold the risks are too high and action is necessary. That threshold must balance the possible impact to the mission, resources available to accomplish that mission, and the technical arid cost feasibility of reducing that risk. In addition, that threshold must balance all of the risks that are associated with a mission. In other words, if there is a practical way to reduce risk, then it is probably prudent to do so. The purpose of this study is to describe one solution for reducing the risk posed by orbital debris. Presently, there are significant quantities of orbit debris in all sizes, altitudes, and inclinations. However, the debris ranges in size from the microscopic to several meters, including worn out satellites arid upper stages of rockets, and fortunately there are many more small objects than large ones. The typical closing velocities for a collision with orbital debris are on the order of 20,000 mph, which means that a collision with a satellite would likely end its useful service life at costs that exceed one billion dollars. With the technological state of the art in orbital debris protection, satellites can he effectively shielded against hypervelocity objects that are less than 1 cm in size. This shielding, however, is extremely expensive. For example, the cost of increasing the protection for critical modules on the Space Station from 1 cm to 2 cm has been calculated to be on the order of 100 million dollars for launch costs alone, not including research and development and manufacturing costs. For objects that are greater than 10-30 cm in size, the Space Station will rely on the Space Command tracking network to provide early warning. If an object will come too close to the station, it will maneuver to avoid it. But the total costs of this maneuvering system are substantive, and we should note that it will not provide absolute protection, principally because the Space Command could have difficulties in continuously tracking objects that are less than 30 cm in size. In the event of a solar flare, the tracking system may lose objects for days at a time. The reality is that there is no system in to protect against the approximately 150,000 objects that are in the range of 1-10 centimeters in size. Using the example of a ten n is ball that is approximately five centimeters; a hypervelocity collision between a tennis hall and a satellite will probably reduce that satellite into orbital debris. And it may have a cascading effect as many smaller objects produce orbital debris, which in turn increases the overall risk to objects in orbit. While the probability of a collision with an individual satellite is quite low, the probability of a collision occurring with in the, entire population of space assets is not as remote. An analysis suggests that with the current level of orbital debris and the sizes of satellites, the probability is that there will be one collision per year. And that loss could amount to billions of dollars. This is a global problem and will involve an international effort that is coordinated by the United Nations. No one project cannot redress this problem. Nor is it economically practical to shield each spacecraft and give it maneuvering capabilities. **An elegant, cost effective, and feasible approach is to use laser technology to solve this problem**. It is estimated that a single, ground- based laser facility that costs about $100 million and that operated near the equator could remove all orbital debris up to an altitude of 800 km in two years. Since satellites typically cost several hundred million and given the half billion price tags on shuttle and Titan launchers, this investment is relatively small given the potential losses of rockets. Furthermore, the development of this technology will stimulate other approaches, including laser power beaming, deflecting asteroids, meteoroids, and comets, and propulsion for interstellar missions. In closing, this study addressed a problem that the international community must resolve if we are to reduce the risk to spaceflight, and hence to economic progress, that is caused by orbital debris.

1AC – Solvency 2/

c. Ground based lasers allow for better tracking of space debris and encourage spill over technology that supercharges our advantages.

Mason, ’11 **(**James, Stupl, Marshall, and Levis, Jan, William and Creon, Scientist @ NASA Ames Research Center, Fellow @ Center for International Security and Cooperation, Scientist @ NASA Ames Research Center, Scientist @ NASA Ames Research Center, “Orbital Debris-Debris Collision Avoidance,” accessed 3-9-11, <http://arxiv.org/PS_cache/arxiv/pdf/1103/1103.1690v1.pdf>)

The described system has a number of alternative uses, which may further improve the value proposition. Firstly, orbit tracks are a byproduct of target acquisition that can be used for orbit determination. Correlating these tracks would allow the generation of a very high accuracy catalog, similar to that being produced by the EOS facility at Mt. Stromlo. The return signal from laser illumination will potentially provide data for accurate estimation of debris albedo and, if the object is large enough to be resolved, size, attitude and spin state; thus helping space situation awareness more generally. Secondly, the concept of shielding high impact debris objects can be applied to protecting active satellites. The laser system could begin engaging the debris object following a high risk debris satellite conjunction alert. The initial engagements would provide additional orbit information that may reduce the risk to an acceptable level. Continued engagement would perturb the debris orbit, potentially saving propellant by avoiding the need for a satellite maneuver. This could even be provided as a commercial service to satellite operators wishing to extend operation lifetimes by saving propellant. Lastly the laser system may also prove useful for making small propellant-less maneuvers of satellites, including those without propulsion, provided the satellite is sufficiently thermally protected to endure 5-minute periods of illumination with a few times the solar constant. This could be used to, for example, enable formation flying clusters of small satellites, or perform small station-keeping maneuvers. Being able to extend smallsat lifetimes without launching to higher altitudes or being able to gradually re-phase a satellite in True Anomaly may also have commercial applications.

d. The US is the best actor to solve space debris.

Ansdell, ’10 (Megan, Grad Student @ George Washington University. “Active Space Debris Removal: Needs, Implications, and Recommendations for Today’s Geopolitical Environment,” [www.princeton.edu/jpia/past-issues-1/2010/Space-Debris-Removal.pdf](http://www.princeton.edu/jpia/past-issues-1/2010/Space-Debris-Removal.pdf).

As previously discussed, a recent NASA study found that annually removing as little as five massive pieces of debris in critical orbits could significantly stabilize the long-term space debris environment (Liou and Johnson 2007). This suggests that **i**t is feasible for one nation to unilaterally develop and deploy an effective debris removal system. As the United States is responsible for creating much of the debris in Earth’s orbit, it is a candidate for taking a leadership role in removing it, along with other heavy polluters of the space environment such as China and Russia. There are several reasons why the United States should take this leadership role, rather than China or Russia. First and foremost, the United States would be hardest hit by the loss of satellites services. It owns about half of the roughly 800 operating satellites in orbit and its military is significantly more dependent upon them than any other entity (Moore 2008). For example, GPS precision-guided munitions are a key component of the “new American way of war” (Dolman 2006, 163-165), which allows the United States to remain a globally dominant military power while also waging war in accordance with its political and ethical values by enabling faster, less costly war fighting with minimal collateral damage (Sheldon 2005). The U.S. Department of Defense recognized the need to protect U.S. satellite systems over ten years ago when it stated in its 1999 Space Policy that, “the ability to access and utilize space is a vital national interest because many of the activities conducted in the medium are critical to U.S. national security and economic well-being” (U.S. Department of Defense 1999, 6). Clearly, the United States has a vested interest in keeping the near-Earth space environment free from threats like space debris and thus assuring U.S. access to space. Moreover, current U.S. National Space Policy asserts that the United States will take a “leadership role” in space debris minimization. This could include the development, deployment, and demonstration of an effective space debris removal system to remove U.S. debris as well as that of other nations, upon their request. There could also be international political and economic advantages associated with being the first country to develop this revolutionary technology. However, there is always the danger of other nations simply benefiting from U.S. investment of its resources in this area. Thus, mechanisms should also be created to avoid a classic “free rider” situation. For example, techniques could be employed to ensure other countries either join in the effort later on or pay appropriate fees to the United States for removal services.

Inherency

Status quo debris mitigation measures will fail – ground-based lasers can remove it all in 3 years

The Economist, ‘10 (“Scientists are increasingly worried about the amount of debris orbiting the Earth” Aug 19th 2010 <http://www.economist.com/node/16843825?story_id=16843825&fsrc=rss>) AK

The real threat now comes from collisions between things that are already up there—so much so that since the demise of *Iridium 33*, the normally secretive Strategic Command (Stratcom) of America’s Defence Department has become rather helpful. Brian Weeden, an expert on space debris at the Secure World Foundation, a think-tank, says Stratcom now screens every operational satellite, every day, looking for close approaches, and notifies all operators. Even the Chinese? “Everybody,” he says, “the Russians, the Chinese, even the Nigerians.” This means that satellites’ owners have better information with which to decide whether to use a small amount of their precious fuel reserves to avoid a collision. But even this would not be enough. What is needed is a way to clean up the junk so that it is no longer a problem. Ideas for doing this are growing almost as fast as space debris. One proposal, originally made a decade ago by the American armed forces, would be to use ground-based lasers to change the orbits of pieces between 1cm and 10cm across by vaporising parts of their surfaces. This would produce enough thrust to cause the debris to re-enter the atmosphere. The proposal suggested a single laser facility would be enough to remove all junk of this size in three years.

Collisions are on the brink- recent collisions have pushed amount of debris to a “tipping point”

Blake, ‘10- Staff Writer at The Daily Telegraph, citing Bharath Gopalaswamy, an Indian rocket scientist specializing in space debris

(Heidi, “Satellites threatened by orbiting rubbish dump,” May 27, Lexis)

SPACE is so littered with debris that a collision between satellites could set off an "uncontrolled chain reaction" capable of destroying the communications network on Earth, according to a Pentagon report. The volume of abandoned rockets, shattered satellites and missile shrapnel in the Earth's orbit is reaching a "tipping point" and is now threatening the $250 billion (£174 billion) space services industry, scientists say. A single collision between two satellites or large pieces of "space junk" could send thousands of pieces of debris spinning into orbit, each capable of destroying further satellites. Global positioning systems, international phone connections, television signals and weather forecasts are among the services at risk of being disrupted, according to the report. This "chain reaction" could leave some orbits so cluttered with debris that they become unusable for commercial or military satellites, the US Defence Department's interim Space Posture Review says. There are also fears that large pieces of debris could threaten the lives of astronauts in space shuttles or at the International Space Station. The report, which was sent to Congress in March and not publicly released, says space is "increasingly congested and contested" and warns that the situation is likely to worsen. Bharath Gopalaswamy, an Indian rocket scientist researching space debris at the Stockholm International Peace Research Institute, estimates that there are now more than 370,000 pieces of junk compared with 1,100 satellites in low-Earth orbit (LEO), between 490 and 620 miles above the planet. A crash in February, 2009, involving a defunct Russian Cosmos satellite and a satellite owned by Iridium Communications Inc left about 1,500 pieces of junk whizzing around the Earth at 4.8 miles a second. A Chinese missile test destroyed a satellite in January, 2007, leaving 150,000 pieces of debris in the atmosphere, according to Dr Gopalaswamy. The space junk, dubbed "an orbiting rubbish dump", also comprises nuts, bolts, gloves and other debris from space missions. "This is almost the tipping point," Dr Gopalaswamy said. "No satellite can be reliably shielded against this kind of destructive force." The Chinese missile test and the Russian satellite crash were key factors in pushing the United States to help the United Nations issue guidelines urging companies and countries not to clutter orbits with junk, the Space Posture Review says.

Inherency

NASA doesn’t have the money for debris removal efforts in the status quo

Moskowitz, 3-10-11 (Clara, “NASA zeroes in on growing space-junk threat,” accessed 5-14-11, <http://www.msnbc.msn.com/id/42014007/ns/technology_and_science-space/t/nasa-zeroes-growing-space-junk-threat/>)

So far, most efforts to combat the space debris threat focus on tracking and predicting possible collisions in time for satellites to [steer out of the way](http://www.space.com/7265-space-junk-forces-shuttle-discovery-dodge-home.html). "The orbital debris that is on orbit right now – it is going to stay there," Lyver said. "There is no [capability](http://www.msnbc.msn.com/id/42014007/ns/technology_and_science-space/t/nasa-zeroes-growing-space-junk-threat/" \t "_blank) right now to remove objects from orbit, or attempt to change them. We just have to be able to avoid them." In addition to the technical and scientific challenges, NASA officials told the committee of [budget constraints](http://www.space.com/11008-nasa-chief-space-budget-congress.html). "We have insufficient manpower to meet requirements," said William Cooke, program manager of the Meteoroid Environment Office at NASA's Marshall Space Flight Center in Huntsville, Ala. "We're stretched extremely thin."

There is no status quo technology that can remove space debris in the short term

Space Security Index, 10 (International Research Consortium, “Space Security 2010,” August 2010, accessed 4-26-11, <http://www.spacesecurity.org/space.security.2010.reduced.pdf>)

In December 2009, NASA and the Defense Advanced Research Projects Agency (DARPA) jointly held the first International Conference on Orbital Debris Removal.67 The conference brought together government, academia, and the private sector to discuss the problem of actively removing space debris from orbit. Various technical solutions were presented, along with discussions on the related economic, legal, and policy challenges. Although some techniques have promise, none have been operationally proven and all have significant nontechnical and political challenges that need to be addressed.

There’s little risk of a debris removal program starting in the short term

Ansdell, 10 (Megan, “Active Space Debris Removal: Needs, Implications, and Reccomendations for Today’s Geopolitical Environment,” accessed 5-14-11, <http://www.princeton.edu/jpia/past-issues-1/2010/Space-Debris-Removal.pdf>)

The biggest challenge, however, will be simply starting the process of active debris removal. Despite growing consensus within the space debris community that active removal will be needed over the next several decades, the fact that space activities continue today without significant interference causes the larger global community to not see space debris as an issue. Moreover, space suffers from the “tragedy of the commons,” a phenomenon that refers to the overexploitation of a shared resource when there is no clear ownership over it. This, in addition to the abovementioned challenges facing debris removal systems, means that the natural tendency of those in power will likely be to do nothing until they absolutely must**.** This is reminiscent of responses to climate change, where the failure of governments to take responsibility for their past actions and act preemptively is compromising the larger global good. Policy makers must therefore take necessary actions, as recommended in next section of this paper, to prevent what is now happening on Earth from also occurring in space.

Harms – Collisions

Debris is increasing – already half a million objects.

McKnight, ’10 (Dr. Darren, “Pay Me Now or Pay Me More Later: Start the Development of Active Orbital Debris Removal Now,” Paper presented at AMOS, Advanced Maui Optical and Space Surveillance Technologies Conference, <http://www.amostech.com/TechnicalPapers/2010.cfm>)

It is estimated by NASA that there are currently over 500,000 cm-size debris objects in LEO. [25] As stated earlier, collisions with objects of this size will likely terminate a satellite’s mission upon impact. Table 1 shows the results of an analysis of how long it would take the cm-size population to double due solely to collisions (i.e. to generate an additional 500,000 cm-size objects in LEO). [Note that this analysis is conservative because it only considers fragments down to 1cm whereas particles as small as 5mm will likely “kill” any satellite it strikes.] A doubling of the hazard from cm-size debris was selected since nominally the annual risk to sun-synchronous satellites of 8E-3 being doubled would surpass the 1.5% (i.e. 1.5E-2) threshold described earlier for space insurance exposure after the first year of satellite operations. While only some LEO satellites are insured, this does provide a fairly reliable and relevant threshold for analysis. It is assumed that about 40,000 fragments larger than 1cm will be created from each “significant” collision of two large intact objects such as payloads or rocket bodies (i.e. ~20,000 objects for each ~3,000kg object). [16] This analysis is very sensitive to the number of debris objects produced from the catastrophic breakup of two large objects which in turn is dependent on collision encounter geometry and physical makeup of each object. Most of the fragmentation data and modeling have focused on payloads and there is much less data available for the result of hypervelocity collisions involving rocket bodies.

High probability of space debris collisions.

McKnight, ’10 (Dr. Darren, “Pay Me Now or Pay Me More Later: Start the Development of Active Orbital Debris Removal Now,” Paper presented at AMOS, Advanced Maui Optical and Space Surveillance Technologies Conference, <http://www.amostech.com/TechnicalPapers/2010.cfm>)

While the probability of a single spacecraft being destroyed, or even just rendered non-operational, by a collision with a large trackable piece of debris is small, the probability that any large object will collide with another is quite a bit higher. The probability of collision for a specific satellite is proportional to the number of objects posing a collision hazard with it while the collision rate between objects is a function of the square of the number of objects present, assuming that the ratio of the large fragments to intact spacecraft is constant with time. [7] In this way, while a hypothetical 20% increase in the population would only produce a 20% increase in collision probability for a single large object, the probability that any two large objects colliding goes up by over 40%. This collision rate is only an approximation since as collisions occur between large objects the ratio of large fragments to intact spacecraft will change. However, early in this process (i.e. for several decades) this approximation introduces very little error. Eventually, this increased collision rate will result in a series of collisions between large objects and the total debris population will start to increase rapidly. In fact, before the 2007 Chinese ASAT event, the average annual increase to the cataloged population was around 250 objects per year. The Chinese test contributed over 2,700 trackable objects (while more than 3,000 have actually been identified) so, this single event contributed over ten years’ worth of population number growth.

Harms – Warming

Satellites are crucial to effective management of emissions and play an indispensable role in halting warming

Ladislaw et al. ‘10 (Sarah O., James Lewis, Denise Zheng, Senior Fellows, Energy and National Security Program “Earth Observation for Climate Change,” <http://csis.org/files/publication/100608_Lewis_EarthObservation_WEB.pdf>, June)

Satellites provide globally consistent observations and the means to make simultaneous observations of diverse measurements that are essential for climate studies. They supply high-accuracy global observations of the atmosphere, ocean, and land surface that cannot be acquired by any other method. Satellite instruments supply accurate measurements on a near-daily basis for long periods and across broad geographic regions. They can reveal global patterns that ground or air sensors would be unable to detect—as in the case of data from NASA satellites that showed us the amount of pollution arriving in North America from Asia as equal to 15 percent of local emissions of the United States and Canada. This sort of data is crucial to effective management of emissions—the United States, for example, could put in place regulations to decrease emissions and find them neutralized by pollution from other regions. 15 Satellites allow us to monitor the pattern of ice-sheet thickening and thinning. While Arctic ice once increased a few centimeters every year, it now melts at a rate of more than one meter annually. This knowledge would not exist without satellite laser altimetry from NASA’s ICESat satellite. 16 Satellite observations serve an indispensable role—they have provided unprecedented knowledge of inaccessible regions. Of the 44 essential climate variables (ECV) recognized as necessary to support the needs of the parties to the UNFCCC for the purposes of the Convention, 26 depend on satellite observations.

Independent of environment collapse – warming triggers water wars, ethnic conflicts, and agricultural collapse.

Dr. Kennedy, who we guarantee will be the most qualified source on the issue, in 2004 (, 6-24-04 started his distinguished career as a neurobiologist. He then served as Commissioner of the FDA and then for 12 years as President of Stanford University. Today, he conducts his research through the Institute for International Studies, focusing on transboundary environmental problems, and is a member of the National Academy of Sciences and editor in chief of Science, the journal of the American Association for the Advancement of Science. http://www.pewclimate.org/docUploads/Kennedy%2Epdf

Now, the standard scenario foresees a slow ramp of global warming, and our projections are based on taking that out essentially indefinitely. But there's another possibility, and the past climate tells us to watch out for it because the past climate is riddled with sudden events that models applied retrospectively failed to predict well. One possible alternative, especially in the North Atlantic, invokes a change in the basic ocean circulation gyre that brings warm water from equatorial regions up through the Gulf Stream, crosses eastward in the North, and the possibility is that as melt water from glaciers or added precipitation dilutes that water in the course of its trip across the North Atlantic, it will now fail to sink, and the return current that must match the upward current of the warm water in the Gulf Stream would be blocked. Well, that scenario, elaborately extended, is the basis for that movie that Eileen told you about, which you should see only for amusement. Beyond the silliness does lie a prospect that is worth taking fairly seriously, and that is that a gradual change in average global temperature may intercept the threshold for some nonlinear dynamic process triggering abrupt change in a direction that we can't now accurately predict. The bottom line from this concern, it seems to me, is, of course, there is uncertainty. The uncertainty comes because we are engaged in a large-scale, uncontrolled experiment on the only planet we have. I want to turn briefly to some impacts that what we know about climate is likely to have on other important global problems. Jim Woolsey is going to talk about security, and I will mention only one aspect of that because it happens to have something to do with how I got interested in the climate problem in the first place. I didn't know very much about climate until the Carnegie Commission on Preventing Deadly Conflict asked a group of us at Stanford to look at environmental change and its possible impacts on regional security in the world. One of the things that we looked at was what might happen in places like the delta of the Ganges and Brahmaputra Rivers, where storm surges now regularly displace large numbers of people and where huge numbers of people, 15 million or so, live within the first meter or two of normal sea level. Some combination of sea level rise and storm surge from more extreme weather events is likely to produce much larger displacements. We know they will have to go somewhere. In the past, they have fled in much smaller numbers to Bengal, where friendly relationships have not followed. The security problems arising from a massive influx of a traditionally hostile population combined with an almost certainly high level of cholera infection does not present a very optimistic picture. Water is a desperately important resource in most parts of the world. Drought is often followed by famine or emigration. Here in the United States, warmer winters threaten mountain snowpacks and will soon demand a revision of interstate and even international water allocation agreements. Maritime rivers are already undertaking management steps to deal with saline intrusions due to sea level rise or storm surges. In Great Britain, the barrier that protects London from occasional flooding of the Thames estuary is now being used six times a year compared to less than once a year in the 1980s. I could mention a couple of others. Agriculture obviously is one of the most vital of human activities. The regional distribution of global warming impacts might provide some temporary help to some kinds of temperate zone agriculture. But surely in the tropics, where the people are poorest and least able to adapt, and where many food crops are near the limit of their physiological tolerance for temperature, the consequence of even a modest warming event could be far more serious. So my point is that climate change is not a problem that can be isolated and talked about as though it were all alone. Instead, it's likely to interact with most of the other problems humans face all over the world.

Harms – Colonization

Solving debris is a prerequisite to space colonization.

Williams, ’10 (Lynda, Physics Instructor, Santa Rosa Junior College, “Irrational Dreams of Space Colonization” Peace Review, a Journal of Social Justice, The New Arms Race in Outer Space (22.1, Spring 2010)

Since the space race began 50 years ago with the launch of Sputnik, the space environment around Earth has become overcrowded with satellites and space debris, so much so, that circumterrestrial space has become a dangerous place with an increasing risk of collision and destruction. Thousands of pieces of space junk created from launches orbit the Earth in the same orbit as satellites, putting them at risk of collision. Every time a rocket is launched, debris from the rocket stages are put into orbital space. In 2009 there was a disastrous collision between an Iridium satellite and a piece of space junk that destroyed the satellite. In 2007 China blew up one of its defunct satellites to demonstrate its antiballistic missile capabilities, increasing the debris field by 15%. There are no international laws prohibiting anti-satellite actions. Every year, since the mid 1980s, a treaty has been introduced into the UN for a Prevention of an Arms Race in Outer Space (PAROS), with all parties including Russia and China voting for it except for the US. How can we hope to pursue a peaceful and environmentally sound route of space exploration without international laws in place that protect space and Earth environments and guarantee that the space race to the moon and beyond does not foster a war over space resources? Indeed, if the space debris problem continues to grow unfettered or if there is war in space, space will become too trashed for launches to take place without risk of destruction.

Space debris makes exploration and development impossible.

Brower et. el., ‘8 (Jared Brower, Stephanie Cook, Edward Dale, Josh Koch, John Miller, Stephanie Silva, All researched for the Global Innovation and Strategy Center, “Eliminating Space Debris: Applied Technology and Policy Prescriptions,” Fall 2008 – Project 07-02)

Space industry profits will exceed $250 billion by the year 2010, according to forecasts published by the BBC.46 Technologies such as telecommunications, global positioning systems, broadband, and remote sensing are being further developed for use in space. Of utmost priority, however, is the need for heightened space situational awareness and space debris elimination measures. Without space debris elimination measures, the possibility of a crescendo, known as the “Kessler Effect,” occurring at current debris levels remains high. In this scenario, large and small debris continually collide and fragment until the atmosphere at LEO becomes unusable. Space-faring nations would lose the ability for space exploration and technology such as The International Space Station (ISS) and Hubble Space Telescope might be compromised. In fact, the NASA space shuttle could also be rendered inoperable. In July 2007, the United Nations voted to adopt orbital debris mitigation guidelines. Many space-faring countries were already operating under similar guidelines established by the Inter-Agency Space Debris Coordination Committee (IADC) in 2002. However, the IADC argued that U.N. adoption of orbital debris mitigation guidelines was necessary. There has been little in the form of policy related to the use of space in regards to debris. The definitive policy to date has been the Outer Space Treaty *of 1967*. Article I of the treaty reads as follows:47 The exploration and use of outer space, including the moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind.

Harms – Solves War

We solve war and escalation of impacts.

a. Satellites prevent warfare by making it impossible to sneak across borders

Dunstan & Szoka, ‘9 – James Dunstan practices space and technology law at Garvey Schubert Barer. Berin Szoka is a Senior Fellow at The Progress & Freedom Foundation, a Director of the Space Frontier Foundation, and member of the FAA’s Commercial Space Transportation Advisory Committee. “Beware Of Space Junk: Global Warming Isn’t the Only Major Environmental Problem,” Tech Liberation Front (TLF), <http://techliberation.com/2009/12/18/beware-of-space-junk-global-warming-isnt-the-only-major-environmental-problem/>.

As world leaders meet in Copenhagen to consider drastic carbon emission restrictions that could require large-scale de-industrialization, experts gathered last week just outside Washington, D.C. to discuss another environmental problem: Space junk.[1] Unlike with climate change, there’s no difference of scientific opinion about this problem—orbital debris counts increased 13% in 2009 alone, with the catalog of tracked objects swelling to 20,000, and estimates of over 300,000 objects in total; most too small to see and all racing around the Earth at over 17,500 miles per hour. Those are speeding bullets, some the size of school buses, and all capable of knocking out a satellite or manned vehicle. At stake are much more than the $200 billion a year satellite and launch industries and jobs that depend on them. Satellites connect the remotest locations in the world; guide us down unfamiliar roads; allow Internet users to view their homes from space; discourage war by making it impossible to hide armies on another country’s borders; are utterly indispensable to American troops in the field; and play a critical role in monitoring climate change and other environmental problems. Orbital debris could block all these benefits for centuries, and prevent us from developing clean energy sources like space solar power satellites, exploring our Solar System and some day making humanity a multi-planetary civilization capable of surviving true climatic catastrophes.

b. Satellite surveillance is key to mutual deterrence, preventing conflict.

Su, ‘10 (Jinyuan,The Silk Road Institute of International Law, School of Law, Xi'an Jiaotong University, China and Visiting Fellow, The Lauterpacht Centre for International Law, University of Cambridge, UK. “The “peaceful purposes” principle in outer space and the Russia-China PPWT Proposal,” PDF.

Nothing of what the states now possess in outer space will be affected in anyway. On the contrary, the main purpose of PPWT is to assure that safety and security of outer space assets is guaranteed. This fully applies to the satellites which provide information services in the interests of national defence of the states.54 In times of peace, such uses as reconnaissance and surveillance produce an important military/political condition of mutual deterrence, with its ultimate valuing of human survival,55 and lessen the possibility of one country surprising the other by aggressive activity, particularly the launching of strategic missiles.56 In times of armed conflicts, the military force-multiplier functions such as communications and global positioning have actually furthered the purposes of humanitarian law by promoting precision and reducing casualties. In the First Gulf War, GPS was credited with increasing the accuracy of coalition force weapons fire, which resulted in fewer civilian casualties and friendly fire shootings, which in turn helped to maintain US public support for the campaign.57 Meanwhile, the PPWT does not prohibit ballistic missiles which, by temporarily flying through outer space before returning to the atmosphere, do not qualify as being “placed” in outer space.58 Neither are terrestrial-based missile defense-related weapons constrained or limited in terms of research, development, testing, production, storage, deployment or operations.59

Harms – Russia War

Space debris causes nuclear war with Russia – their Early Warning System will mistake a collision and panic.

Lewis, ‘4 – postdoctoral fellow in the Advanced Metods of Cooperative Study Program; worked in the office of the Undersecretary of Defense for Policy [Jeffrey, Center for Defense Information, “What if Space were Weaponized?” July 2004, <http://www.cdi.org/PDFs/scenarios.pdf>]

This is the second of two scenarios that consider how U.S. space weapons might create incentives for America’s opponents to behave in dangerous ways. The previous scenario looked at the systemic risk of accidents that could arise from keeping nuclear weapons on high alert to guard against a space weapons attack. This section focuses on the risk that a single accident in space, such as a piece of space debris striking a Russian early-warning satellite, might be the catalyst for an accidental nuclear war. As we have noted in an earlier section, the United States canceled its own ASAT program in the 1980s over concerns that the deployment of these weapons might be deeply destabiliz- ing. For all the talk about a “new relationship” between the United States and Russia, both sides retain thousands of nuclear forces on alert and con•gured to •ght a nuclear war. When briefed about the size and status of U.S. nuclear forces, President George W. Bush reportedly asked “What do we need all these weapons for?”43 The answer, as it was during the Cold War, is that the forces remain on alert to conduct a number of possible contingencies, including a nuclear strike against Russia. This fact, of course, is not lost on the Rus- sian leadership, which has been increasing its reliance on nuclear weapons to compensate for the country’s declining military might. In the mid-1990s, Russia dropped its pledge to refrain from the “•rst use” of nuclear weapons and conducted a series of exercises in which Russian nuclear forces prepared to use nuclear weapons to repel a NATO invasion. In October 2003, Russian Defense Minister Sergei Ivanov reiter- ated that Moscow might use nuclear weapons “preemptively” in any number of contingencies, including a NATO attack.44 So, it remains business as usual with U.S. and Russian nuclear forces. And business as usual includes the occasional false alarm of a nuclear attack. There have been several of these incidents over the years. In September 1983, as a relatively new Soviet early-warning satellite moved into position to monitor U.S. missile •elds in North Dakota, the sun lined up in just such a way as to fool the Russian satellite into reporting that half a dozen U.S. missiles had been launched at the Soviet Union. Perhaps mindful that a brand new satel- lite might malfunction, the of•cer in charge of the command center that monitored data from the early-warning satellites refused to pass the alert to his superiors. He reportedly explained his caution by saying: “When people start a war, they don’t start it with only •ve missiles. You can do little damage with just •ve missiles.”45 In January 1995, Norwegian scientists launched a sounding rocket on a trajectory similar to one that a U.S. Trident missile might take if it were launched to blind Russian radars with a high altitude nuclear detonation. The incident was apparently serious enough that, the next day, Russian President Boris Yeltsin stated that he had activated his “nuclear football” – a device that allows the Russian president to communicate with his military advisors and review his options for launching his arsenal. In this case, the Russian early-warning satellites could clearly see that no attack was under way and the crisis passed without incident.46 In both cases, Russian observers were con•-dent that what appeared to be a “small” attack was not a fragmentary picture of a much larger one. In the case of the Norwegian sounding rocket, space-based sensors played a crucial role in assuring the Russian leadership that it was not under attack. The Russian command sys-tem, however, is no longer able to provide such reliable, early warning. The dissolution of the Soviet Union cost Moscow several radar stations in newly independent states, creating “attack cor-ridors” through which Moscow could not see an attack launched by U.S. nuclear submarines.47 Further, Russia’s constellation of early-warn-ing satellites has been allowed to decline – only one or two of the six satellites remain operational, leaving Russia with early warning for only six hours a day. Russia is attempting to reconstitute its constellation of early-warning satellites, with several launches planned in the next few years. But Russia will still have limited warning and will depend heavily on its space-based systems to provide warning of an American attack.48 As the previous section explained, the Penta- gon is contemplating military missions in space that will improve U.S. ability to cripple Russian nuclear forces in a crisis before they can execute an attack on the United States. Anti-satellite weapons, in this scenario, would blind Russian reconnaissance and warning satellites and knock out communications satellites. Such strikes might be the prelude to a full-scale attack, or a limited ef- fort, as attempted in a war game at Schriever Air Force Base, to conduct “early deterrence strikes” to signal U.S. resolve and control escalation.49 By 2010, the United States may, in fact, have an arsenal of ASATs (perhaps even on orbit 24/7) ready to conduct these kinds of missions – to coerce opponents and, if necessary, support preemptive attacks. Moscow would certainly have to worry that these ASATs could be used in conjunction with other space-enabled systems – for example, long-range strike systems that could attack targets in less than 90 minutes – to disable Russia’s nuclear deterrent before the Rus- sian leadership understood what was going on. What would happen if a piece of space debris were to disable a Russian early-warning satel-lite under these conditions? Could the Russian military distinguish between an accident in space and the •rst phase of a U.S. attack? Most Russian early-warning satellites are in elliptical Molniya orbits (a few are in GEO) and thus dif•cult to attack from the ground or air. At a minimum, Moscow would probably have some tactical warn-ing of such a suspicious launch, but given the sorry state of Russia’s warning, optical imaging and signals intelligence satellites there is reason to ask the question. Further, the advent of U.S. on-orbit ASATs, as now envisioned50 could make both the more dif•cult orbital plane and any warning systems moot. The unpleasant truth is that the Russians likely would have to make a judgment call. No state has the ability to de•nitively deter-mine the cause of the satellite’s failure. Even the United States does not maintain (nor is it likely to have in place by 2010) a sophisticated space surveillance system that would allow it to distin- guish between a satellite malfunction, a debris strike or a deliberate attack – and Russian space surveillance capabilities are much more limited by comparison. Even the risk assessments for col-lision with debris are speculative, particularly for the unique orbits in which Russian early-warning satellites operate. During peacetime, it is easy to imagine that the Russians would conclude that the loss of a satellite was either a malfunction or a debris strike. But how con•dent could U.S. planners be that the Russians would be so calm if the accident in space occurred in tandem with a second false alarm, or occurred during the middle of a crisis? What might happen if the debris strike oc-curred shortly after a false alarm showing a mis-sile launch? False alarms are appallingly common – according to information obtained under the Freedom of Information Act, the U.S.-Canadian North American Aerospace Defense Command (NORAD) experienced 1,172 “moderately seri-ous” false alarms between 1977 and 1983 – an average of almost three false alarms per week. Comparable information is not available about the Russian system, but there is no reason to believe that it is any more reliable.51 Assessing the likelihood of these sorts of co- incidences is dif•cult because Russia has never provided data about the frequency or duration of false alarms; nor indicated how seriously early- warning data is taken by Russian leaders. More- over, there is no reliable estimate of the debris risk for Russian satellites in highly elliptical orbits.52 The important point, however, is that such a coincidence would only appear suspicious if the United States were in the business of disabling satellites – in other words, there is much less risk if Washington does not develop ASATs. The loss of an early-warning satellite could look rather ominous if it occurred during a period of major tension in the relationship. While NATO no longer sees Russia as much of a threat, the same cannot be said of the converse. Despite the warm talk, Russian leaders remain wary of NATO expansion, particularly the effect expan- sion may have on the Baltic port of Kaliningrad. Although part of Russia, Kaliningrad is separated from the rest of Russia by Lithuania and Poland. Russia has already complained about its decreas- ing lack of access to the port, particularly the uncooperative attitude of the Lithuanian govern- ment.53 News reports suggest that an edgy Russia may have moved tactical nuclear weapons into the enclave.54 If the Lithuanian government were to close access to Kaliningrad in a •t of pique, this would trigger a major crisis between NATO and Russia. Under these circumstances, the loss of an early-warning satellite would be extremely suspi-cious. It is any military’s nature during a crisis to interpret events in their worst-case light. For ex- ample, consider the coincidences that occurred in early September 1956, during the extraordinarily tense period in international relations marked by the Suez Crisis and Hungarian uprising.55 On one evening the White House received messages indicating: 1. the Turkish Air Force had gone on alert in response to unidenti•ed aircraft penetrat- ing its airspace; 2. one hundred Soviet MiG-15s were •ying over Syria; 3. a British Canberra bomber had been shot down over Syria, most likely by a MiG; and 4. The Russian •eet was moving through the Dardanelles. Gen. Andrew Goodpaster was reported to have worried that the con•uence of events “might trigger off … the NATO operations plan” that called for a nuclear strike on the Soviet Union. Yet, all of these reports were false. The “jets” over Turkey were a •ock of swans; the Soviet MiGs over Syria were a smaller, routine escort returning the president from a state visit to Mos- cow; the bomber crashed due to mechanical dif•culties; and the Soviet •eet was beginning long-scheduled exercises. In an important sense, these were not “coincidences” but rather different manifestations of a common failure – human er- ror resulting from extreme tension of an interna- tional crisis. As one author noted, “The detection and misinterpretation of these events, against the context of world tensions from Hungary and Suez, was the •rst major example of how the size and complexity of worldwide electronic warning systems could, at certain critical times, create momentum of its own.” Perhaps most worrisome, the United States might be blithely unaware of the degree to which the Russians were concerned about its actions and inadvertently escalate a crisis. During the early 1980s, the Soviet Union suffered a major “war scare” during which time its leadership concluded that bilateral relations were rapidly declining. This war scare was driven in part by the rhetoric of the Reagan administration, forti•ed by the selective reading of intelligence. During this period, NATO conducted a major command post exercise, Able Archer, that caused some elements of the Soviet military to raise their alert status. American of•cials were stunned to learn, after the fact, that the Kremlin had been acutely nervous about an American •rst strike during this period.56 All of these incidents have a common theme – that confidence is often the difference between war and peace. In times of crisis, false alarms can have a momentum of their own. As in the second scenario in this monograph, the lesson is that commanders rely on the steady •ow of reli-able information. When that information flow is disrupted – whether by a deliberate attack or an accident – confidence collapses and the re- sult is panic and escalation. Introducing ASAT weapons into this mix is all the more dangerous, because such weapons target the elements of the command system that keep leaders aware, informed and in control. As a result, the mere presence of such weapons is corrosive to the con•dence that allows national nuclear forces to operate safely.

Harms – Hegemony

Space debris threatens the entire US military.

Brower et. el., ‘8 (Jared Brower, Stephanie Cook, Edward Dale, Josh Koch, John Miller, Stephanie Silva, All researched for the Global Innovation and Strategy Center, “Eliminating Space Debris: Applied Technology and Policy Prescriptions,” Fall 2008 – Project 07-02)

“Many objects have been jettisoned into space: lens covers, auxiliary motors, launch vehicle fairings, separation bolts used to lock fixtures in place...and objects merely dropped or discarded during manned missions.”2 That outer space exploration would create by-products is not surprising; every human venture in history has carried inefficiencies. While outer space seemed limitless a half-century ago, the Space Age has exemplified how quickly orbits around the Earth can be filled. Space debris has evolved from an environmental nuisance to a serious hazard; the U.S. space shuttle flies backwards and upside down to avoid the problem.3 With tens of millions of debris fragments flying at high velocity through lower earth orbit, both human explorers and space hardware are vulnerable. General Kevin P. Chilton, head of United States Strategic Command, recently wrote: “Military and civilian entities are heavily reliant on services that satellites provide, and space operations are so pervasive that it is impossible to imagine the U.S. functioning without them.”4 During *Operation Desert Storm*, commercial satellites provided 45% of all communications between the theater and the continental United States.5 Today, according to General Chilton, “We rely on satellites to verify treaty compliance, monitor threats and provide advance warning of missile attacks. It's important to remember that every soldier, sailor, Marine and airman in Iraq and Afghanistan relies on space technology for crucial advantages in the field.”6 Commercially, the economy of the United States is heavily dependent on space assets in virtually every industry. Communications, Global Positioning System (GPS) technology, agriculture, weather monitoring, and shipment tracking in the manufacturing sector are all indispensable to workings of the market.7, 8 With international economies interwoven across borders and cultures, damage to a critical satellite might pose serious monetary repercussions throughout multiple countries. For example, nearly a decade ago the failure of the Galaxy IV satellite rendered certain communications useless for two days. “The failure of that one satellite left about 80 (to) 90 percent of the 45 million pager customers in the United States without service...and 5400 of 7700 Chevron gas stations without pay-at-the-pump capability.”9 *U.S. News and World Report* recently reviewed an exercise simulating a day in the life of the U.S. military without satellites; the deputy under secretary of the Air Force for space programs was questioned about the results. “Fundamentally, you go back to fighting a war like World War II where it’s huge attrition rates, huge logistics, and huge expenses.”10 This example certainly speaks to the reliance on space assets. A lack of action to secure space assets might prove even costlier. In a knowledge-based, information-driven economy, the ability to communicate effectively and quickly is sacrosanct. The Economist recently painted the determination of the outcomes of future conflicts as a matter of “Brains, Not Bullets.”11 If information superiority is today’s manifest destiny, the security of space assets is not optional.

Loss of satellites sets US capabilities back 75 years – communications are vital

Johnson & Hudson, ‘8 – Lt Kevin Johnson and John G Hudson, Ph. D. \*\*NOTE – Johnson and Hudson = project supervisors @ Global Innovation and Strategy Center (GISC) Internship program. This program assembles combined teams of graduate and undergraduate students with the goal of providing a multidisciplinary, unclassified, non-military perspective on important Department of Defense issues. “Global Innovation and Strategy Center,” <http://www.slideshare.net/stephaniclark/giscinternpaperspacedebriselimination>.

U.S. News and World Report recently reviewed an exercise simulating a day in the life of the U.S. military without satellites; the Deputy Under Secretary of the Air Force for Space Programs was questioned about the results. “Fundamentally, you go back to fighting a war like World War II where it’s huge attrition rates, huge logistics, and huge expenses.”10 This example certainly speaks to the reliance on space assets. A lack of action to secure space assets might prove even costlier. In a knowledge-based, information-driven economy, the ability to communicate effectively and quickly is sacrosanct. The Economist recently painted the determination of the outcomes of future conflicts as a matter of “Brains, Not Bullets.”11 If information superiority is today’s manifest destiny, the security of space assets is not optional.

Harms – Hegemony

Space debris collisions collapse hegemony – the military relies on satellites for all battle planning

Imburgia, ‘11- Lieutenant Colonel in the US Army, Judge Advocate for the USAF (Joseph, “Space Debris and Its Threat to National Security: A Proposal for a Binding International Agreement to Clean Up the Junk,” Vanderbilt Journal of Transnational Law, Volume 44, Number 3, May)

These gloomy prognostications about the threats to our space environment should be troubling to Americans. The United States relies on the unhindered use of outer space for national security.151 According to a space commission led by former Secretary of Defense Donald Rumsfeld, “[t]he [United States] is more dependent on space than any other nation.”152 According to Robert G. Joseph, former Undersecretary for Arms Control and International Security at the State Department, “space capabilities are vital to our national security and to our economic well-being.”153 Therefore, a **catastrophic collision between space debris and the satellites on which that national security so heavily depends poses a very real and current threat to the national security interests of the United States.** Since “the [1991] Gulf War, the [United States] military has depended on satellites for communications, intelligence and navigation for its troops and precision-guided weapons.”154 Satellites are also used for reconnaissance and surveillance, command and control, and control of Unmanned Aerial Vehicles.155 According to the United States Space Command’s Fact Sheet: Satellites provide essential in-theater secure communications, weather and navigational data for ground, air and fleet operations and threat warning. Ground-based radar and Defense Support Program satellites monitor ballistic missile launches around the world to guard against a surprise missile attack on North America. Space surveillance radars provide vital information on the location of satellites and space debris for the nation and the world. Maintaining space superiority is an emerging capability required to protect our space assets.156 With the modern speed of warfare, it has become difficult to fight conflicts without the timely intelligence and information that space assets provide. Space-based assets and space-controlled assets have created among U.S. military commanders “a nearly insatiable desire for live video surveillance, especially as provided from remotely piloted vehicles like the Predator and now the Reaper.”157 Moreover, military forces have become so dependent on satellite communications and targeting capabilities that the loss of such a satellite would “badly damage their ability to respond to a military emergency**.”**158 In fact, the May 2008 malfunction of a communications satellite demonstrates the fragile nature of the satellite communications system.159 The temporary loss of a single satellite “effectively pulled the plug on what executives said could [have been] as much as 90 percent of the paging network in the United States.”160 Although this country’s paging network is perhaps not vital to its national security, the incident demonstrates the possible national security risks created by the simultaneous loss of multiple satellites due to space debris collisions. Simply put, the United States depends on space-based assets for national security, and those assets are vulnerable to space debris collisions. As Massachusetts Democratic Congressman Edward Markey stated, “American satellites are the soft underbelly of our national security.”161 The Rumsfeld Commission set the groundwork for such a conclusion in 2001, when it discussed the vulnerability of U.S. space-based assets and warned of the Space Pearl Harbor.162 Congress also recognized this vulnerability in June 2006, when it held hearings concerning space and its import to U.S. national power and security.163 In his June 2006 Congressional Statement, Lieutenant General C. Robert Kehler, then the Deputy Commander, United States Strategic Command, stated that “space capabilities are that these space capabilities are “vital to our daily efforts throughout the world in all aspects of modern warfare” and discussed how integral space capabilities are to “defeating terrorist threats, defending the homeland in depth, shaping the choices of countries at strategic crossroads and preventing hostile states and actors from acquiring or using WMD.”165 Because so much of the United States’ security depends on satellites, these integral space-based capabilities would, therefore, be costly to lose. That loss would be felt in more than just the security arena. Due to the steep price tags attached to some of the national space security platforms, the economic loss of a satellite due to space debris would also be significant. For example, a pair of new Global Positioning Satellites (GPS), which provides valuable targeting and battle space awareness to military commanders, costs $1.5 billion.166 Accordingly, if a piece of space debris destroys one of these satellites, $750 million could be lost instantly. Additionally, NASA invests billions of dollars annually in space assets. Congress provided NASA with $18.3 billion to spend on space utilization and exploration for fiscal year 2010, and it provided $17.7 billion for fiscal year 2011.167 Air Force General (retired) Ronald E. Keys, former Commander of Air Combat Command, summed it up best, stating that a great deal “rides on space-borne satellites.”168 Because these space capabilities are so costly yet so vital to the United States’ national security and economic well-being, the preservation of these space capabilities should also be vital. Unfortunately, as the Rumsfeld Commission noted, “the threat to the [United States] and its allies in and from space does not command the attention it merits.”169 This problem was echoed when, on April 28, 2010, experts from NASA, the U.S. military, industry, and academia provided testimony to the U.S. House of Representatives Subcommittee on Space and Aeronautics.170 “According to subcommittee Chairwoman Gabrielle Giffords of Arizona, the general conclusion of the hearing was that the problem is serious and the world needs to take concrete steps to address it.”171 To rectify this problem from a legal standpoint, and to immediately counter the national security threat that space debris presents, there must be a fundamental shift in how the United States and the international community perceive space debris. Rather than thinking about space debris in terms of its overall increase to the amount of man-made material in space, **we must look at space debris in terms of the considerable risk that it poses to national security.** Toward that end, the international community needs aggressive space debris removal and reduction efforts on a global scale, and it can effectuate the necessary change through international law. Without a collective international legal effort to induce a reduction in space debris, it will only be a matter of time before the free use of space is severely imperiled, if not forever lost.172

Solvency – Small Debris Key

Small debris is key – large objects can be avoided.

Brower et. el., ‘8 (Jared Brower, Stephanie Cook, Edward Dale, Josh Koch, John Miller, Stephanie Silva, All researched for the Global Innovation and Strategy Center, “Eliminating Space Debris: Applied Technology and Policy Prescriptions,” Fall 2008 – Project 07-02)

Millions of tiny space debris particles orbit the earth today, some travelling ten times faster than a high-powered rifle bullet.29 30 According to NASA scientist and space debris expert Dr. Nicholas Johnson, millimeter fragmentations are a greater threat than larger objects like defunct satellites as they are too small to be tracked with current technology.31 The estimated 11,000 objects large enough to be tracked are catalogued and monitored, enabling satellite operators to maneuver around them by expending additional fuel.32 When small debris pieces collide with space assets, the result is not simply a matter of speed, but also of motion. “Because the (low earth orbit) velocities are so high, the kinetic energy is very high. It’s the equivalent of exploding several sticks of dynamite in your spacecraft,” noted a BBC report on the problem.33 Debris fragments as small as one-tenth of one millimeter could potentially puncture the suit of an astronaut.34 The “Kessler effect”35 complicates matters further: as the volume of satellites increases, so does the probability that they will collide with each other.36 Such a chain reaction is “inevitable,” according to Dr. Nicholas Johnson37 in an interview with *The New York Times,* “A significant piece of debris will run into an old rocket body, and that will create more debris. It’s a bad situation.” In summary, while preventative measures against debris creation are vital, they will not prevent further growth arising from existing debris.

Small debris is the critical internal link

Ansdell, ’10 (Megan, Grad Student @ George Washington University. “Active Space Debris Removal: Needs, Implications, and Recommendations for Today’s Geopolitical Environment,” [www.princeton.edu/jpia/past-issues-1/2010/Space-Debris-Removal.pdf](http://www.princeton.edu/jpia/past-issues-1/2010/Space-Debris-Removal.pdf).

The most dangerous pieces of space debris are those ranging in diameter from one to ten centimeters, of which there are roughly 300,000 in orbit. These are large enough to cause serious damage, yet current sensor networks cannot track them and there is no practical method for shielding spacecraft against them. Consequently, this class of orbital debris poses an invisible threat to operating satellites (Wright 2007, 36). Debris larger than ten centimeters, of which there are roughly 19,000 in orbit, can also incapacitate satellites but they are large enough to be tracked and thus potentially avoided. Debris smaller than one centimeter, in contrast, cannot be tracked or avoided, but can be protected against by using relatively simple shielding (Wright 2007, 36).

Solvency – Lasers

Lasers are effective.

Kelly, ’11 (Mike, “UAH researcher Dr. John Campbell offers solutions to space debris problem, May 23, 2011, <http://www.al.com/42/index.ssf/2011/05/uah_researcher_offers_solution.html>)

HUNTSVILLE, Alabama -- The use of low-powered lasers could be a major part of the solution to the growing problem of debris in space, according to Dr. John Campbell. The UAH researcher was part of a three-man panel on space debris at the the International Space Development Conference, which ended Sunday. "Getting control of this problem is essential to the future of spaceflight," said Campbell, a research scientist at the UAH Research Institute. The most recent studies show hundreds of thousands of objects orbiting in space at altitudes of low Earth orbit and higher. These objects, ranging in size from almost microscopic to complete satellites, orbit at nearly 18,000 miles per hour and pose a threat to space travel, Campbell said. **Lasers could help deflect objects from their normal orbits**, bringing them down to upper Earth atmosphere level, where friction with the atmosphere would further slow them down and cause them to burn up. He presented a two-part solution: ground-based lasers with orbiting "geo-orbital lasers" as the best solution. The use of lasers, Campbell emphasized, is only part of a comprehensive solution. "We have to understand that there are no complete solutions at this time," he said. The focus of concern is on objects of 1 to 10 centimeters, and a single ground-based facility near the Earth's equator, he said, could remove most objects of this size range at a cost of $100 to $300 million. Success of the laser solution would require enhanced surveillance efforts to track the debris. Development and implementation of a space surveillance network, a main topic at the Global Space Surveillance Panel, would go hand in hand in helping solve the problem. The largest object in orbit, the International Space Station, is especially vulnerable. Campbell said the ISS averages "about one evasive maneuver per month" to dodge space debris. "For years we felt this was a risk we had to take," he said. The extreme velocities of the debris are much more than a spacecraft is designed to handle, Campbell said. The growing problem prompted NASA and the Defense Advanced Research Projects Agency to convene a conference in 2009 to address the issue. He also emphasized the importance of involving America's global space partners in the effort.

Lasers work – NASA study proves it’s possible.

Choi, ’11 (Charles Q, SPACE.com Contributor, “Earth-based Lasers Could Zap Space Junk Clear From Satellites,” 17 March 2011, http://www.space.com/11157-nasa-lasers-shooting-space-junk.html)

Lasers on the ground could be used to nudge debris in orbit, which could help move dangerous space junk away from satellites and spacecraft, scientists working with NASA suggest. Space debris might not sound like much of a threat until one realizes that in low-Earth orbit, "these objects are typically going at about 7.5 kilometers per second, or almost 17,000 miles per hour," said physicist James Mason, a NASA contract scientist at the Universities Space Research Association. "To put this in perspective, a 1-ounce piece of debris traveling at this velocity has about the same kinetic energy as a 2-ton car traveling at 60 miles per hour." The problem that debris poses gets worse when collisions spawn even more debris, eventually cluttering space with high-speed shrapnel, a scenario nicknamed "Kessler syndrome" after NASA scientist Donald Kessler, who predicted it in 1978. "The February 2009 collision between an active Iridium sat-phone satellite and a defunct Russian Cosmos weather satellite was the first example of an active satellite being catastrophically destroyed in an accidental collision," Mason said. "Collisions like this were predicted by Kessler in 1978, and he predicted that if the number of debris in certain orbits got high enough then there would be a cascading series of collisions that might eventually render whole orbits unusable." [Worst Space Debris Events of All Time] This runaway cascade of destruction is probably already in effect in some orbits around the Earth, he added. "According to NASA's Orbital Debris Program Office, we have passed this critical density of objects in the low-Earth orbit at about 900 to 1,000 kilometers (560 to 620 miles) altitude," Mason said. "Even with no new launches and with the responsible post-mission disposal of dead satellites or rockets, their models predict that the population is going to continue to grow in this region." Zapping space junk A number of proposals have been floated to help clean up this garbage, such as rendezvousing with large objects like rocket bodies and propelling them back at Earth. However, such missions would be complex and expensive. Instead of going up into space to bring down garbage, scientists have suggested remaining on the ground and zapping it with lasers. A 1996 study from NASA dubbed Project ORION that was co-sponsored by the U.S. Air Force proposed using powerful beams to vaporize surface material on targets, providing enough recoil to drive it Earthward. The problem, of course, is that such lasers could be seen as weapons threatening other spacefaring nations. Now, Mason and his colleagues at NASA Ames Center and Stanford University suggest much less powerful and far cheaper lasers that can push debris without damaging it. How lasers move space trash Light can exert a push on matter, a fact that scientists have used to develop solar sails that can fly through space on sunlight. The researchers suggest that a medium-power commercially available laser with a 5-to-10-kilowatt beam constantly focused on a piece of debris could work, located someplace such as the Plateau Observatory in Antarctica.

Solvency – Lasers

Ground-based lasers are the most cost effective solution.

Johnson & Hudson, ‘8 – Lt Kevin Johnson and John G Hudson, Ph. D. \*\*NOTE – Johnson and Hudson = project supervisors @ Global Innovation and Strategy Center (GISC) Internship program. This program assembles combined teams of graduate and undergraduate students with the goal of providing a multidisciplinary, unclassified, non-military perspective on important Department of Defense issues. “Global Innovation and Strategy Center,” <http://www.slideshare.net/stephaniclark/giscinternpaperspacedebriselimination>.

The Orion study concluded that removing debris 1-10 cm in diameter from LEO is technically feasible in the near term. The study showed that debris removal with the Orion laser concept is less expensive than increasing the shielding of the ISS from 1 cm to 2 cm. There are some disagreements as to the abilities of adaptive optics to illuminate debris, so further analysis or a demonstration is needed. A physical demonstration within Orion parameters would provide proof of concept. There should also be serious consideration given to including more recent laser technology advances such as the Mercury Laser as possible removal mechanisms. Ongoing work such as the IAA study and the IAP/Quantron/IPIE workgroup on debris removal techniques should provide updated cost numbers and give a better indication of the technical feasibility of a ground-based laser system. Ground-based lasers were given an 8.0 rating in our analysis based on relatively low operating costs and ability to remove a large number of small debris in a short amount of time. At present, there is not enough damage caused to satellites in orbit due to debris to justify the costs of building a full-scale debris removal system. However, if debris models are determined to be overly optimistic with respect to natural de-orbiting of debris or debris-causing events such as the Chinese ASAT test continue to occur, a GBL is a feasible way to eliminate debris. A GBL is far less expensive to implement than including enhanced shielding on space objects. Although the Orion laser can be tested with government-furnished equipment, international cooperation should be strongly encouraged in developing a full-scale debris removal system. For example, the Russians have made significant progress in Orion-type technologies and “are eager to apply these to an international project.”184

Lasers solve debris – are quick and cost effective

Campbell, 2000 (Jonathan, Colonel in the United States Air Force Reserve “Using Lasers in Space”. December 2000. <http://www.nss.org/resources/library/planetarydefense/2000-LaserOrbitalDebrisRemovalAndAsteroidDeflection-Campbell.pdf>)

Orbital debris in tow-Earth orbit ranging in size from 1 to 10 centimeters (cm) in diameter, poses a significant problem for space vehicles.1 While this debris can he detected, it cannot he tracked with sufficient reliability to permit spacecraft to avoid these objects. Such debris can cause catastrophic damage even to a shielded spacecraft. Given the technological advances associated with adaptive optics, a ground-based pulsed laser could ablate or vaporize the surface of orbital debris, thereby producing enough cumulative thrust to cause debris to reenter the atmosphere. One laser facility could remove all of the one-ten centimeter debris in three years or less. This study proposes that the United States develop a technology demonstration of this laser space propulsion in order to implement a system for removing debris from earth orbit. The cost of this proposed demonstration is favorable in comparison with the typical costs [or spacecraft operations.

Ground based lasers are better than space based- quickest response time

Karl, ‘6 engineer with NAFEMS an independent, not-for-profit organisation that sets and maintains standards in computer-aided engineering analysis and, specifically, finite element analysis (FEA) (Alexander, “ACTIVE REMOVAL OF SPACE DEBRIS – DISCUSSING TECHNICAL AND ECONOMICAL ISSUES”)

The ground based laser system appears to be more feasible and promoting since the power required to operate the laser in space would be far greater than most spacecraft, including the ISS, can generate and the time would not be enough it would take humans to detect and target an object coming over the horizon before it either hits or passes the craft [1, 16]. Although spaceborne nuclear powered lasers have been proposed [18] and automatic target systems are a possibility the highly complex nature of the spaceborne detection and tracking system in combination with the short time spans to react to a possible threat favour the ground based system further. In comparison, to plan and perform evasive maneuvers, the Shuttle requires 45 minutes warning in advance to gradually change the orbit so not to stress the structure of the Shuttle too much. [19]

Solvency – Lasers

Lasers clear space debris quickly and effectively – long term gains outweigh short term costs

Campbell, 2000 (Jonathan, Colonel in the United States Air Force Reserve “Using Lasers in Space”. December 2000. <http://www.nss.org/resources/library/planetarydefense/2000-LaserOrbitalDebrisRemovalAndAsteroidDeflection-Campbell.pdf>)

We have demonstrated in the laboratory that laser energy can he used for propulsion on a wide range of uncooperative debris surfaces, and that spreading of a laser related to turbulence in the atmosphere can he overcome by adaptive optics. In this section, we will examine strategies for removing orbital debris with an ground-based pulsed laser. Let us assume a fairly difficult target, a 1-cm diameter Na/K sphere, of which there are believed to he tens of thousands from the leakage of a liquid metal reactor coolant in orbit. These targets are difficult because of their low area-to-mass ratios and the higher optimum intensity for a metal surface. The laser is taken to be a 1.06 µm, 20 kJ, 5 ns laser pulsed at 5 Hz. We assume the target is in a 500 km x 600 km elliptical orbit, and passes over the laser as it is between apogee and perigee. The effects of individual hits are shown in Figure 3 as a function of zenith angle. The single pulse effects on the perigee, apogee, and lifetime are small but significant. The effects are generally beneficial at positive zenith angles (target approaching the laser). In Figure 3 we exhibit the cumulative effect on the lifetime of engagements over zenith angle ranges. The final lifetime is plotted as a function of the starting zenith angle, assuming zero ending zenith angle. The initial lifetime of this target is about 171 days. An engagement that begins at 60 degrees reduces this to just 20 days and leaves the target in a 317 km by 595 km orbit. The figure shows the importance of firing at large zenith angles. At the larger angles, the apparent angular speed of the target is low, and there is time for more pulses than at smaller zenith angles. This and similar analyses show that all orbital debris in low earth orbit can he removed in one or more engagement’ consisting of pulses delivered by a single ground-based laser. The laser of this example is capable of removing debris up to 800 km in altitude in two or three years of operation. Technology Demonstration. The serious international concern over the orbital debris problem, when coupled with the evident feasibility and cost-effectiveness of debris removal by ground-based pulsed laser propulsion, has led to planning for the next step toward debris removal. The Orion report contained a suggestion for a technology demonstration in which a 120-J pulsed laser would he joined with a 3.5 m aperture telescope with tracking capability, such as the USAF Advanced Electro-Optical System (AEOS) under construction in Hawaii or the Starfire Optical Range (SOR) in New Mexico. Specially constructed targets, which would he deployed from the space shuttle, would have corner-cube reflectors or a UPS unit to return a strong signal for calibration tests. This demonstration would have a number of goals. Cost estimates for the technology demonstration are in the range of $13-28 million, which is comparable with the cost of a single flight of the least expensive orbital launch vehicle (Pegasus). The potential benefits, if the demonstration leads to an operational system, are saving tens of millions of dollars per year in expenses (increased shielding, damage control systems, and satellite replacements) related to orbital debris, and the accelerated development of other applications of laser space propulsion and laser power beaming.

Ground Based Lasers are effective in stopping space debris.

Dahl 10(Sarah, Major, USAF “Is it time for space debris removal”, <https://www.afresearch.org/skins/rims/q_mod_be0e99f3-fc56-4ccb-8dfe-670c0822a153/q_act_downloadpaper/q_obj_ebe8b7d6-fd6b-4522-8615-c350adc97d87/display.aspx?rs=enginespage>)

The optimal intensity of the laser energy depends on the material of the debris and the laser pulses’ duration to create 25 this propulsion. “This system would be effective against both metallic and nonmetallic targets in space, and could be effective against materials that are in higher orbital altitudes.” Although technically feasible, another study conducted in 2000 assessed whether it was cost effective. This study used the Iridium satellite system and the number of objects in LEO as a basis for their estimate. The $3.450 billion system is comprised of 66 satellites (each satellite being worth approximately $50 million), and the estimated amount of damage to satellites in this orbit was found to be $40M per year. The study concluded that one ground-based laser facility operating near the equator “could remove all orbital debris up to an altitude of 800 km in two years” for about $100 to 200M. The team also recommended a technical demonstration study to further this concept, but it is unknown at this time as to whether anything is underway to make this capability a reality. However, one of the challenges facing the employment of this solution would likely be the ground facility’s dependency with the tracking capabilities existing today. It would seem that for this ground-based laser facility to be effective, it would require dedicated and improved tracking capabilities to track debris smaller than 10-cm, which again, can still damage a satellite and create more debris). Thus, the costs associated with this solution may not truly include a system level approach to employment.

Solvency – Lasers

Laser solve space debris.

Schumacher, ’10 (Cindy, “Conference Explores Space Debris Threats and Solutions,” January 21, 2010 <http://www.mauiweekly.com/page/content.detail/id/500916/Conference-Explores-Space-Debris-Threats-and-Solutions.html?nav=13>)

On May 21, 2009, the Maui Weekly reported on the importance of raising public awareness of the growing risks posed by space debris—a point of discussion at the 5th Annual European Space Debris Conference in Darmstadt, Germany. And because of the risks from continued proliferation of space debris, NASA and DARPA (Defense Advanced Research Projects Agency) sponsored the first-ever International Conference on Orbital Debris Removal near Washington, D.C., last month. In the last two years, collisions between satellites and explosions of rocket boosters in orbit around the Earth have added many thousands of debris fragments to the orbiting population. And any one of these fragments could disable or destroy operating satellites or manned spacecraft. Maui resident Dr. Mark Skinner, a senior scientist and technical manager at Boeing’s Maui Space Surveillance Site, attended the conference of nearly 300 participants and 60 speakers. Dr. Skinner noted the importance of the subject for Boeing and the community at large. “Technology in space, worth trillions of dollars altogether, provides so much to our daily lives,” Dr. Skinner said. “We hardly realize or think about our dependence on a clean space environment. Space debris is a major threat to business in the 21st century,” he said. Our dependence on space systems for weather data, navigation and vital reconnaissance is growing. Space systems provide modern business communications, remote sensing, and digital television and music for millions of consumers. Boeing is a leading manufacturer of satellites in the world. “We are prepared to promote the adoption and implementation of space debris removal measures to support our customer’s mission operations in space,” said Dr. Skinner. Maui plays a great role in the detection of space debris. “It is a key location for tracking space objects to counter possible catastrophic impacts,” he said. Conference speakers offered advanced concepts for debris removal that included lasers, tethers, solar sails and other brilliant methods of moving debris objects out of often-used orbits. For example, short pulses of high-powered laser beams from stations on the ground can vaporize a tiny amount of the mass of the debris object hundreds of miles out in space. The puff of plasma vapor generated by the laser’s heat would provide a small momentary rocket thrust, slowing the object down so it can re-enter the Earth’s atmosphere.

Ground based laser system is key to development and use of nano satellites

Raimondi, ’11 (Michael, “A Gentle Touch For Space Junk Removal,” 3-17-11, <http://www.trajectoryofeverything.com/2011/03/gentle-touch-for-space-junk-removal.html>)

The authors also suggest the telescope-and-laser system could be employed to boost the orbits of small satellites**.** This is an intriguing notion to me. [**Nano- and pico-satellites**](http://en.wikipedia.org/wiki/Miniaturized_satellite)**are** a relatively recent development, but they're limited by a lack of thrusters. Without thrust, the orbits of tiny satellites inevitably decay and the vehicle burns up as it reenters the atmosphere. But imagine if the satellite operators could purchase time on a ground-based laser facility. The laser would push their satellite to a higher orbit, provided it has the correct mass-to-area ratio. This sounds promising because it provides thrust "on demand", without much additional capital cost on the part of the satellite operator.

Solvency – Concept Demonstration

US development of a laser gets other actors involved.

Brower et. el. ‘8 (Jared Brower, Stephanie Cook, Edward Dale, Josh Koch, John Miller, Stephanie Silva, All researched for the Global Innovation and Strategy Center, “Eliminating Space Debris: Applied Technology and Policy Prescriptions,” Fall 2008 – Project 07-02)

Domestic Policy Recommendations

United States space policies have evolved to a formal recognition of the debris problem through the creation of national space debris mitigation guidelines. Although decades of research have given policymakers multiple options for debris remediation, the research remains untested. A debris removal demonstration is needed and should be domestically proposed and international in scope. Signaling the serious nature of the problem through global outreach, such a demonstration would enable the scientific community to move beyond theoretical debris removal techniques to practical applications. A conduit for funding of applied research would then be opened, with an exercise of actual debris removal as the next logical step towards enhanced science and policy. Funding goes hand-in-hand with a demonstration. A successful demonstration of debris removal would offer an international platform for funding aimed at the long-term goal of a sustainable space environment. Existing debris is a sunk cost; focusing on future remediation would enable consideration of a global funding construct. For example, a small fee could be incorporated into each satellite launch to build a funding pool that would be made available once international consensus was reached on viable technologies. With nearly 50 countries investing in space assets today, long-term prospects speak to the logic of pooled resources for future remediation efforts.

Solvency – US Key

US should lead in the removal of space debris

Ansdell, ‘10 (Megan, Grad Student @ George Washington University’s Elliot School of Int’l Affairs, where she focused on space policy. “Active Space Debris Removal: Needs, Implications, and Recommendations for Today’s Geopolitical Environment,” [www.princeton.edu/jpia/past-issues-1/2010/Space-Debris-Removal.pdf](http://www.princeton.edu/jpia/past-issues-1/2010/Space-Debris-Removal.pdf).

Need to Initiate Unilateral Action International cooperation in space has rarely resulted in cost-effective or expedient solutions, especially in politically-charged areas of uncertain technological feasibility. The International Space Station, because of both political and technical setbacks, has taken over two decades to deploy and cost many billions of dollars—far more time and money than was originally intended. Space debris mitigation has also encountered aversion in international forums. The topic was brought up in COPUOS as early as 1980, yet a policy failed to develop despite a steady ﬂow of documents on the increasing danger of space debris (Perek 1991). In fact, COPUOS did not adopt debris mitigation guidelines until 2007 and, even then, they were legally non-binding. Space debris removal systems could take decades to develop and deploy through international partnerships due to the many interdisciplinary challenges they face. Given the need to start actively removing space debris sooner rather than later to ensure the continued beneﬁts of satellite services, international cooperation may not be the most appropriate mechanism for instigating the ﬁrst space debris removal system. Instead one country should take a leadership role by establishing a national space debris removal program. This would accelerate technology development and demonstration, which would, in turn, build-up trust and hasten international participation in space debris removal. Possibilities of Leadership As previously discussed, a recent NASA study found that annually removing as little as five massive pieces of debris in critical orbits could significantly stabilize the long-term space debris environment (Liou and Johnson 2007). This suggests that it is feasible for one nation to unilaterally develop and deploy an effective debris removal system. As the United States is responsible for creating much of the debris in Earth’s orbit, it is a candidate for taking a leadership role in removing it, along with other heavy polluters of the space environment such as China and Russia. There are several reasons why the United States should take this leadership role, rather than China or Russia. First and foremost, the United States would be hardest hit by the loss of satellites services. It owns about half of the roughly 800 operating satellites in orbit and its military is significantly more dependent upon them than any other entity (Moore 2008). For example, GPS precision-guided munitions are a key component of the “new American way of war” (Dolman 2006, 163-165), which allows the United States to remain a globally dominant military power while also waging war in accordance with its political and ethical values by enabling faster, less costly war fighting with minimal collateral damage (Sheldon 2005). The U.S. Department of Defense recognized the need to protect U.S. satellite systems over ten years ago when it stated in its 1999 Space Policy that, “the ability to access and utilize space is a vital national interest because many of the activities conducted in the medium are critical to U.S. national security and economic well-being” (U.S. Department of Defense 1999, 6). Clearly, the United States has a vested interest in keeping the near-Earth space environment free from threats like space debris and thus assuring U.S. access to space. Moreover, current U.S. National Space Policy asserts that the United States will take a “leadership role” in space debris minimization. This could include the development, deployment, and demonstration of an effective space debris removal system to remove U.S. debris as well as that of other nations, upon their request.

Unilateral action solves the case better AND results in cooperation.

Ansdell, ‘10 (Megan, Grad Student @ George Washington University’s Elliot School of Int’l Affairs, where she focused on space policy. “Active Space Debris Removal: Needs, Implications, and Recommendations for Today’s Geopolitical Environment,” [www.princeton.edu/jpia/past-issues-1/2010/Space-Debris-Removal.pdf](http://www.princeton.edu/jpia/past-issues-1/2010/Space-Debris-Removal.pdf).

International cooperation in space has rarely resulted in cost-effective or expedient solutions, especially in politically-charged areas of uncertain technological feasibility. The International Space Station, because of both political and technical setbacks, has taken over two decades to deploy and cost many billions of dollars—far more time and money than was originally intended. Space debris mitigation has also encountered aversion in international forums. The topic was brought up in COPUOS as early as 1980, yet a policy failed to develop despite a steady flow of documents on the increasing danger of space debris (Perek 1991). In fact, COPUOS did not adopt debris mitigation guidelines until 2007 and, even then, they were legally non-binding. Space debris removal systems could take decades to develop and deploy through international partnerships due to the many interdisciplinary challenges they face. Given the need to start actively removing space debris sooner rather than later to ensure the continued benefits of satellite services, international cooperation may not be the most appropriate mechanism for instigating the first space debris removal system. Instead, IG one country should take a leadership role by establishing a national space debris removal program. This would accelerate technology development and demonstration, which would, in turn, build-up trust and hasten international participation in space debris removal.

Solvency – US Key

Only unilateral action is effective in debris removal

Ansdell, ‘10 (Megan, Grad Student @ George Washington University’s Elliot School of Int’l Affairs, where she focused on space policy. “Active Space Debris Removal: Needs, Implications, and Recommendations for Today’s Geopolitical Environment,” [www.princeton.edu/jpia/past-issues-1/2010/Space-Debris-Removal.pdf](http://www.princeton.edu/jpia/past-issues-1/2010/Space-Debris-Removal.pdf).

If the United States and other powerful governments do not take steps now to avert the potentially devastating effects of space debris, the issue risks becoming stalemated in a manner similar to climate change. Given the past hesitation of international forums in addressing the space debris issue, unilateral action is the most appropriate means of instigating space debris removal within the needed timeframe. The United States is well poised for a leadership role in space debris removal. Going forward, the U.S. government should work closely with the commercial sector in this endeavor, focusing on removing pieces of U.S. debris with the greatest potential to contribute to future collisions. It should also keep its space debris removal system as open and transparent as possible to allow for future international cooperation in this field. Although leadership in space debris removal will entail certain risks, investing early in preserving the near-Earth space environment is necessary to protect the satellite technology that is so vital to the U.S. military and day-to-day operations of the global economy**.** By instituting global space debris removal measures, a critical opportunity exists to mitigate and minimize the potential damage of space debris and ensure the sustainable development of the near-Earth space environment.

US action is key--other countries don’t have the tech

Space Daily, ‘9(“Making The Space Environment Safer For Civil And Commercial Users” 5/4/09 LexisNexis)

The House Committee on Science and Technology's Subcommittee on Space and Aeronautics held a hearing to examine the challenges faced by civil and commercial space users as space traffic and space debris in Earth orbit continue to increase. Subcommittee Members questioned witnesses about potential measures to improve the information available to civil and commercial users to avoid in-space collisions and discussed ways to minimize the growth of future space debris. Ensuring the future safety of civil and commercial spacecraft and satellites is becoming a major concern. The February 2009 collision between an Iridium Satellite-owned communications satellite and a defunct Russian Cosmos satellite highlighted the growing problem of space debris and the need to minimize the chances of in-space collisions. "It was such a surprise to me and many others when we heard the news that two satellites had collided in orbit in February of this year. It was hard to believe that space had gotten that crowded. It was equally difficult to believe that nothing could have been done to prevent the collision, given that one of the satellites was active and by all accounts would have had the capability to maneuver out of harm's way," said Subcommittee Chairwoman Gabrielle Giffords (D-AZ). "I'd like to know where things stand, and what we're going to do to keep such an event from happening again." While several nations such as Russia, France, Germany and Japan have some form of space surveillance capability, these systems are not interconnected and are neither as capable nor as robust as the United States' Space Surveillance Network (SSN)**.** SSN consists of a world-wide network of 29 ground-based sensors that are stated to be capable of tracking objects as small as five centimeters orbiting in Low Earth Orbit (LEO)-that is, the region of space below the altitude of 2,000 km (about 1,250 miles). For the last four years, the Department of Defense (DOD) has undertaken a Commercial and Foreign Entities (CFE) pilot program to make collision avoidance information available to commercial space users. Commercial users have found the service to be very useful and have been concerned about uncertainty concerning the CFE program's future. At the hearing, Gen. Larry James, Commander of the Joint Functional Component Command for Space, testified that the DoD would transition the CFE to an operational program later this year. Since 1957, there have been several thousand payloads launched into space. After the first fragmentation of a man-made satellite in 1961, there have been more than 190 fragmentations and 4 accidental collisions. Since January of 2007, there have been three major debris generating incidents, which have significantly increased the Earth's orbital debris environment: Iridium 33 - Cosmos 2251 Satellite Collision; Chinese A-SAT test on Fengyun-1C; and Russian spent stage explosion - Russian Arabsat 4. At this point, the DoD is tracking more than 19,000 objects in Earth orbit, and witnesses at the hearing testified that there are more than 300,000 objects of a half-inch in size or larger orbiting the Earth, with further growth in the debris population anticipated in the coming years. "One thing is already clear-the space environment is getting increasingly crowded due to the relentless growth of space debris. If the spacefaring nations of the world don't take steps to minimize the growth of space junk, we may eventually face a situation where low Earth orbit becomes a risky place to carry out civil and commercial space activities," said Giffords.

2AC – Topicality

We meet – we remove a barrier to both parts of the resolution.

Spacedebate.org, ’11 *(*<http://www.spacedebate.org/argument/2213#2151>)

Space debris is a significant threat to space **exploration** and **development**

We’re T – Development

Carroll, ‘2 (Joseph A., Tether Applications, Inc., “Space Transport Development Using Orbital Debris, Final Report on NIAC Phase I Research Grant No. 07600-087, December 2, 2002)

The last task in our proposed Phase I effort was 4.4, “Flesh out a development scenario and identify potential issues and applications.” This chapter does that, and also presents our detailed recommendations for future work both by us and by others. It discusses both our proposed Phase II work, and also the larger efforts that must be done by NASA and industry after that, to bring debris collection and sling technology into practice. The key steps that we envision are listed below. The rest of the chapter discusses each step in some detail.

Possible Steps in Development Scenario 1. Determine what might be capturable and how to do the captures (NIAC Phase II, year 1). 2. Develop detailed shepherd architecture and operating scenarios (NIAC Phase II, year 2). 3. Develop adequate ED tether dynamics simulation capabilities (NASA MXER effort). 4. Develop suitable ED and strength tethers and capture hardware (NASA MXER effort). 5. Select a suitable inspector-type satellite as a “sheepdog” and adapt and enhance as required. 6. Complete development of EDDE (solar arrays and array steering, integration, etc.) 7. Flight-test EDDE or another suitable precursor with a sheepdog (preferably by 2008). 8. Refinesystemdesignconceptsbasedonwhatislearnedfromtheflightexperiment 9. Launch shepherds and sheepdogs to deboost LEO debris near solar max (2010-2014?). 10. If slings do indeed look feasible, assemble ballast and other components and operate slings. 11. Build a safe-abort payload carrier to allow intact-abort with suborbital payloads. 12. Eventually, develop an RLV optimized to launch payloads for suborbital capture by sling.

2AC – Weaponization

Lasers vaporize debris without being perceived as offensive weaponization

Johnson & Hudson, ‘8 – Lt Kevin Johnson and John G Hudson, Ph. D. \*\*NOTE – Johnson and Hudson = project supervisors @ Global Innovation and Strategy Center (GISC) Internship program. This program assembles combined teams of graduate and undergraduate students with the goal of providing a multidisciplinary, unclassified, non-military perspective on important Department of Defense issues. “Global Innovation and Strategy Center,” <http://www.slideshare.net/stephaniclark/giscinternpaperspacedebriselimination>.

Ground-based lasers (GBL) have been proposed as a solution to remove small debris (1-10 cm) in LEO. There are two main components to any laser removal system: a targeting system and the actual directed-energy device. With radar based tracking or high-sensitivity optics, debris of 1 cm diameter or greater can be detected and targeted. Once the debris has been located and targeted, it is hit with short pulses from a laser. The pulses vaporize or ablate a micro-thin layer of the object, causing plasma blow-off. The result is a dramatic change in the object’s orbit, lowering its perigee, reducing its orbital lifespan and allowing it to burn up in the earth’s atmosphere. Opponents of a GBL system may argue that it could be used as an anti-satellite weapon. A GBL system is designed for small debris and only ablates a few layers of molecules from the surface of the object. It would take months of dedicated operation to de-orbit even a medium-sized satellite. This approach does, however, have the potential to blind certain sensors on a satellite, but this effect can be avoided with proper operating procedures at the device location.

Space Weaponization inevitable – BMD and China Test prove

Stratfor, ‘8 ( “United States: The Weaponization of Space”, 4/10/08, <http://www.stratfor.com/analysis/united_states_weaponization_space>)

In the 1950s, the United States began pushing for an international treaty on outer space — even before the 1957 launch of Sputnik atop a modified version of the world’s first intercontinental ballistic missile. Fortunes have changed somewhat in the last 50 years, and the Pentagon has little interest in taking on further legally binding constraints these days. This is especially true in space, where “weaponization” is not only inevitable, but already well under way. In 1967, Washington became party to the “Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies” (better known as the Outer Space Treaty). This treaty was quickly and readily accepted, in part because of its utter lack of definitions. Aside from some fairly unequivocal language about prohibiting the deployment of nuclear weapons in outer space and more broad military activities on the moon and other celestial bodies, the treaty is much more a loose collection of very large holes than it is a constraint on sovereign national action in space. Since then, the military utility of space has begun to be realized. Today, it is a cornerstone of global military communications and navigation. In Iraq today, for example, the U.S. military uses the Global Positioning System (GPS) for everything from squad level maneuvers to joint direct attack munition (JDAM) delivery. Largely from facilities inside the continental United States, the Pentagon controls some unmanned aerial systems half a world away. GPS has given rise to a new degree of precision in guided weapons. Imagery from space-based surveillance platforms has become commonplace and the Defense Support Program constellation continually monitors the surface of the earth for the launch plume of a ballistic missile. It is an incredibly valuable military domain. And just as it has become more valuable, the United States has become increasingly dependent on it. Thus, space-based assets are susceptible targets for U.S. adversaries. Were the United States to lose these assets, its military capability on the ground would be severely affected. Any symmetric enemy knows that and will act to neutralize U.S. space capability. The United States knows that this attack will take place and must therefore defend the assets. In this sense, space is already a domain of military competition and conflict. There is no escaping it. In other words, space has already been weaponized, except that the actual projectiles are not yet located in space. Beijing’s 2007 and Washington’s recent anti-satellite weapons tests only emphasize this point.

Debris removal is the exception – international efforts prevent the link.

Rose, ’10 [Frank A. Rose Deputy Assistant Secretary, Bureau of Arms Control, Verification and Compliance, Remarks at the USSTRATCOM Space Symposium. “International Cooperation: Furthering U.S. National Space Policy and Goals” November 2, 2010 <http://www.state.gov/t/avc/rls/150316.htm>]

As was discussed earlier, congestion in space is becoming an increasingly difficult challenge and addressing it will require international action. There are now around 21,000 pieces of space debris in various Earth orbits – in other words, about 6,000 metric tons of debris orbiting the Earth. Some of this debris was created accidentally through collisions or routine space launches, some was intentional such as the Chinese ASAT test in 2007. Not only is there a direct economic impact to this debris, it also adds to the overall magnitude of hazards in critical orbits, such as those used by the space shuttle and the International Space Station. For example, the space shuttle is impacted by debris repeatedly on every mission. In fact, debris poses the single largest threat to the shuttle and to the astronauts onboard during these missions. The typical risk of the space shuttle being critically impacted by debris is about one in 250. To address the growing problem of orbital debris, the United States plans to expand its engagement within the United Nations and with other governments and non-governmental organizations. We are continuing to lead the development and adoption of international standards to minimize debris, building upon the foundation of the U.N. Space Debris Mitigation Guidelines. The United States is also engaged with our European allies and partners and other like-minded nations on a multi-year study of “long-term sustainability” within the Scientific and Technical Committee of the U.N. Committee on the Peaceful Uses of Outer Space, or COPUOS. This effort will provide a valuable opportunity for cooperation with established and emerging space actors and with the private sector to establish a set of “best practice” guidelines that will enhance space-flight safety. In collaboration with other space-faring nations, the United States is also pursuing research and development of technologies and techniques to mitigate on-orbit debris, reduce hazards, and increase our understanding of the current and future debris environment. These activities provide valuable opportunities and benefits for expanded international cooperation with the global space-faring community and the private sector, and also contribute to preserving the space environment for future generations.

2AC – Weaponization

Solving space debris eliminates the incentive to built more aggressive space weapons in response.

Tehran times. ’10 [12/25/2010, “Space junk rivals weapons as a major threat” <http://www.tehrantimes.com/Index_view.asp?code=232812>]

What began as a minor trash problem in space has now developed into a full-blown threat. A recent space security report put the problem of debris on equal footing with weapons as a threat to the future use of space. Hundreds of thousands of pieces of space junk — including broken satellites, discarded rocket stages and lost spacewalker tools — now crowd the corridors of Earth orbit. These objects could do serious damage to working spacecraft if they were to hit them, and might even pose a risk to people and property on the ground if they fall back to Earth and are large enough to survive re-entering the atmosphere. The new Space Security 2010 report released by the Space Security Index, an international research consortium, represented space debris as a primary issue. Similar recognition of the orbital trash threat also emerged in the U.S. national space policy unveiled by President Obama in June 2010. Such growing awareness of the space debris problem builds on stark warnings issued in past years by scientists and military commanders, experts said. It could also pave the way for U.S. agencies and others to better figure out how to clean up Earth orbit. Consideration of space debris as a major threat may cause the United States to take a more global view on the threat of space weapons, said Brian Weeden, a former U.S. Air Force orbital analyst and now technical adviser for the Secure World Foundation, an organization dedicated to the sustainable use of space. “This is an important realization, because before that much of the security focus was on threats from hostile actors in space,” Weeden explained. “This is the first [national policy] recognition that threats can come from the space environment and nonhostile events.” All those bits of garbage in space could eventually create a floating artificial barrier that endangers spaceflight for any nation, experts said. Even fictional space navigator Han Solo might prefer to risk turbolaser blasts from Imperial starships rather than hazard Earth's growing cloud of space debris, where objects whiz by at up to 4.8 miles per second (7.8 km/s). The possibility of a damaging collision between spacecraft and orbital junk only continues to grow with more functional and nonfunctional hardware flying above Earth. Both the International Space Station and space shuttle missions have been forced to dodge space debris in the past. More than 21,000 objects larger than 4 inches (10 centimeters) in diameter are being tracked by the Department of Defense's U.S. Space Surveillance Network. Estimates suggest there are more than 300,000 objects larger than 0.4 inches (1 cm), not including several million smaller pieces. The “shuttle was more likely to be wiped out by something you didn't see than something you were dodging,” said Donald Kessler, a former NASA researcher and now an orbital debris and meteoroid consultant in Asheville, N.C. But the problem has become much worse since Kessler began studying the issue decades ago with Burton Cour-Palais, a fellow NASA researcher. Their 1978 research described how the debris cloud might continue expanding on its own because of an ever-higher probability of collisions that built upon each past collision. That prediction, known as the Kessler Syndrome, may have already been realized. China's intentional destruction of an aging weather satellite during a 2007 anti-satellite test created about 2,500 pieces of new debris in Earth orbit. More recently, a U.S. Iridium communications satellite and a defunct Soviet Cosmos spacecraft were destroyed in an unintended head-on collision in 2009. That incident added more than 1,000 pieces of trackable debris to the mess, adding to the number of possible targets and therefore upping the chances of future collisions. The overall trackable amount of space debris grew by about 15.6 percent, according to the Space Security 2010 report. NASA and other U.S. agencies could use national space policy as a chance to aggressively pursue solutions, such as using spacecraft propelled by solar radiation (solar sails) or other objects to take down a few select pieces of debris, experts said. “If we only bring down four objects per year, we can stabilize [the debris field] if we carefully select those most likely to contribute to debris,” Kessler told SPACE.com. The national space policy shift shows that policymakers have finally begun to take action based on the work of Kessler and other researchers, Weeden said. “This policy basically sets the playing field for what is to come,” Weeden said. “It's an enabler, not the actual solution itself.”

2AC – Spending DA

Laser is cost effective- one laser costs only eight hundred thousand dollars- too small to affect space weaponization

Choi, ‘11 (Charles Q., March 17, http://www.space.com/11157-nasa-lasers-shooting-space-junk.html, 2011)

The 5-kilowatt laser would cost about $800,000, and a single device could probably engage about 10 objects a day. However, the scientists do note that the actual cost of an operating system, including telescope, would likely be tens of millions of dollars. It may be possible to perform a nearly free demonstration of this idea using existing capabilities, such as those of the Starfire Optical Range at Kirtland Air Force Base. The researchers do stress that any system should be done as an international collaboration because of the obvious space warfare implications. [7 Sci-Fi Weapons of Tomorrow Today] "The main question that needs to be answered is what is the long-term effect on the overall debris situation?" Mason said, "We need to do population modeling to determine if the system really will be sufficient to halt or slow the Kessler syndrome. We hope to work closely in the future with colleagues at NASA to model the effects." The scientists note this system could be used to give a nudge to more than just garbage — they could push specially designed satellites, helping them save weight on propellant. As to whether or not these nudges have the potential for use in space warfare, "generally, for large objects like satellites, the force is too small to significantly affect the orbit," Mason said.

Lasers are cheap- can divert thousands of pieces of debris for the cost of one launch

Michaels, ‘9 (Daniel, “A Cosmic Question: How to Get Rid Of All That Orbiting Space Junk?” <http://online.wsj.com/article/SB123672891900989069.html>, March 11)

"I thought it would be a Buck Rogers thing," the astrophysicist recalls. Instead, his team concluded that for the price of one space-shuttle launch -- roughly $500 million -- the laser could nudge thousands of bits of garbage toward incineration in the atmosphere within five years. Compared to the cost of losing a satellite or a shuttle to space debris impact, "this looks like a bargain," says Dr. Campbell, who works at NASA's Marshall Space Flight Center in Huntsville, Ala. A key to his plan is using existing low-power lasers in quick pulses, much like the flashbulb on a camera. The laser would only singe the surface of an object in space, but that tiny burn could still help point it downward, Dr. Campbell says. Project Orion's low-budget approach hits at a conundrum of space debris.

Must act now – delaying action costs billions.

McKnight, ’10 (Dr. Darren, “Pay Me Now or Pay Me More Later: Start the Development of Active Orbital Debris Removal Now,” Paper presented at AMOS, Advanced Maui Optical and Space Surveillance Technologies Conference, <http://www.amostech.com/TechnicalPapers/2010.cfm>)

Current perceived and actual risks are below the threshold for immediate action. However, delaying action may cause us to go through a period of satellite failures due to collisions with debris. Eventually, the spacefaring community will expend more resources “recovering” from multiple collisions rather than proactively starting to remove large objects. This delay will cost the community 100’s of millions of dollars to billions of dollars in debris cleanup and satellite replacement costs plus difficult-to-calculate impact due to termination of services supported by on-orbit assets.

2AC – Politics

No Link and Turn—recent funding increases for space protection prove Congress would be receptive to the plan

Day, ‘9 (Dwayne, “The gun pointed at the head of the universe,” Space Review, 6/15, <http://www.thespacereview.com/article/1394/1>)

Another person asked about the current level of effort in the United States for dealing with space protection. Palowitch noted that in the past year Congress has put $3.2 billion into the issue, and over $5 billion in the last seven years. But Palowitch said that substantial infusion of cash in recent years comes after a long and steady decline, so there’s no reason to expect the situation to improve in the immediate future. Meanwhile, the amount of debris in orbit is increasing.

If they Delay CP…

Every delay multiplies the amount of debris.

McKnight, ’10 (Dr. Darren, “Pay Me Now or Pay Me More Later: Start the Development of Active Orbital Debris Removal Now,” Paper presented at AMOS, Advanced Maui Optical and Space Surveillance Technologies Conference, <http://www.amostech.com/TechnicalPapers/2010.cfm>)

As the debris population worsens some of the removal options may not be as viable as currently depicted. For example, while the electrodynamic tether approach has some very positive supporting analytic calculations, the tethers do present a large collision cross-section for the on-orbit debris population. If deployment of this option is delayed until the mm- and cm-size population is significantly larger, mission success may be greatly reduced, resulting in much larger removal costs and potentially making the solution less reliable and less effective.

2AC – Limit/Minimize CP

Only destroying debris can solve, mitigation strategies not enough.

David, ‘11 (Leonard David has been reporting on the space industry for more than five decades. He is a winner of this year’s National Space Club Press Award and a past editor-in-chief of the National Space Society's Ad Astra and Space World magazines. “Ugly Truth of Space Junk: Orbital Debris Problem to Triple by 2030, 09 May 2011, http://www.space.com/11607-space-junk-rising-orbital-debris-levels-2030.html)

COLORADO SPRINGS, Colo. -- Dealing with the decades of detritus from using outer space -- human-made orbital debris -- is a global concern, but some experts are now questioning the feasibility of the wide range of "solutions" sketched out to grapple with high-speed space litter. What may be shaping up is an "abandon in place" posture for certain orbital altitudes -- an outlook that flags the messy message resulting from countless bits of orbital refuse. In a recent conference here, Gen. William Shelton, commander of the U.S. Air Force Space Command, relayed his worries about rising amounts of human-made space junk. "The traffic is increasing. We've now got over 50 nations that are participants in the space environment," Shelton said last month during the Space Foundation’s 27th National Space Symposium. Given existing space situational awareness capabilities, over 20,000 objects are now tracked. [Worst Space Debris Events of All Time] "We catalog those routinely and keep track of them. That number is projected to triple by 2030, and much of that is improved sensors, but some of that is increased traffic," Shelton said. "Then if you think about it, there are probably 10 times more objects in space than we're able to track with our sensor capability today. Those objects are untrackable … yet they are lethal to our space systems -- to military space systems, civil space systems, commercial -- no one’s immune from the threats that are on orbit today, just due to the traffic in space." Tough neighborhood From a probability point of view, General Shelton added, smaller satellites, more debris, more debris is going to run into more debris, creating more debris. [Video: Fragmentation: Growing Threat of Space Junk] "It may be a pretty tough neighborhood," Shelton continued, in low-Earth orbit and geosynchronous Earth orbit "in the not too distant future." When asked if the U.S. Air Force plans on funding space debris mitigation capability, Shelton responded: "We haven’t found a way yet that is affordable and gives us any hope for mitigating space debris. The best we can do, we believe, is to minimize debris as we go forward with our operations. As we think about how we launch things, as we deploy satellites, minimizing debris is absolutely essential and we’re trying to convince other nations of that imperative as well." Shelton said that, unfortunately, with the duration of most things on orbit, "you get to live with the debris problem for many, many years and in some cases decades. So minimizing debris is important to us and it should be to other nations as well." Point of no return The concern over orbital debris has been building for several reasons, said Marshall Kaplan, an orbital debris expert within the Space Department at the Johns Hopkins University Applied Physics Laboratory in Laurel, Md. In Kaplan's view, spacefaring nations have passed the point of "no return," with the accumulation of debris objects in low-Earth orbits steadily building over the past 50 years. Add to the clutter, the leftovers of China’s anti-satellite (ASAT) test in 2007. "The fact that this single event increased the number of debris objects by roughly 25 percent was not as important as the location of the intercept. The event took place at an altitude of 865 kilometers, right in the middle of the most congested region of low-orbiting satellites," Kaplan pointed out. Toss into the brew the collision of an Iridium satellite with an expired Russian Cosmos spacecraft in February 2009 -- at an altitude similar to that of China’s ASAT test. As a result of 50 years of launching satellites and these two events, the altitude band from about 435 miles (700 km) to a little over 800 miles (1,300 km) has accumulated possibly millions of debris objects ranging from a few millimeters to a few meters, Kaplan said.

Evening stopping missions won’t solve – need active effort to eliminate debris.

Brower et. el., ‘8 (Jared Brower, Stephanie Cook, Edward Dale, Josh Koch, John Miller, Stephanie Silva, All researched for the Global Innovation and Strategy Center, “Eliminating Space Debris: Applied Technology and Policy Prescriptions,” Fall 2008 – Project 07-02)

NASA Scientist Dr. Nicholas Johnson has projected the growth of debris over time if no mitigation action is taken. In addition, he has used the data is to forecast the impact of debris mitigation efforts beginning in the year 2020 and assuming that 5, 10, and 20 pieces of debris are eliminated yearly beginning 2020. Based on this data, Figure 1 portrays the estimated numbers of anticipated collisions by year based on varied levels of mitigation. The top, solid line (thickest) shows projected collision numbers if no mitigation effort is made. Although the number does not seem too alarming at first, eventually expected collisions begin to rise exponentially. However, if a significant effort is made to remove debris, even though space activity increases dramatically, the risk of collision remains virtually the same as current levels. If the orbital debris population remained as it is today with no additional space operations, the level of fragmentation in Earth’s orbit would continue to escalate exponentially. Dr. Nicholas Johnson, chief scientist for orbital debris for NASA at the Johnson Space Center, has modeled future orbital debris scenarios based on non- mitigation over a 5, 10, and 20 year period compared to the removal of one to five pieces of debris beginning in the year 2020. This paper, co-authored by J.-C. Liou and titled “A Sensitivity Study of the Effectiveness of Active Debris Removal in LEO,” suggests that the orbital debris population can be effectively addressed by simply removing five objects per year starting in the year 2020.

2AC – Surveillance/ Monitor CP

Surveillance isn’t enough – doesn’t solve collisions.

McKnight, ’10 (Dr. Darren, “Pay Me Now or Pay Me More Later: Start the Development of Active Orbital Debris Removal Now,” Paper presented at AMOS, Advanced Maui Optical and Space Surveillance Technologies Conference, <http://www.amostech.com/TechnicalPapers/2010.cfm>)

Better space surveillance: Much of the analysis in this paper is based on the fact that the hazard from the “lethal risk” (i.e. cm-size debris) is the eventual concern that may trigger the need to remove orbital debris. If this regime of the debris population could be seen reliably and avoided by operational, maneuverable satellites then the entire situation might change. This, however, is only possible with new hardware and software. In addition, this may not be as much of a solution as one might expect. Just seeing an object is not sufficient to being able to avoid it. There must be good orbital element set information for the debris to produce data to create small covariance matrices that would permit accurate probability of collision values to be determined. This requires regular observations of smaller debris. However, smaller objects are generally more affected by atmospheric drag in LEO so it will be more difficult to maintain precise orbital elements on them (or at least it will require more frequent observations). The U.S.’s proposed S-band fence may contribute to both the ability to track and provide accurate element sets on smaller orbiting objects, if implemented as currently envisioned. [20] There are about 1,800 derelict rocket bodies and nearly 3,200 payloads in orbit. None of the abandoned rocket bodies have the capability to avoid collisions with other objects. Of the 3,200 payloads, only 1,000 are operational and nearly 800 of those are maneuverable with over half of those located in GEO. As a result, most of the mass in orbit (about 80%) cannot avoid disastrous collisions even if it was predicted and warned about in advance.

2AC – Code of Conduct CP

The CP crushes the aerospace industry.

International Astronautical Federation, ‘8 (Space Debris, <http://www.iafastro.net/index.php?id=558>)

A group of space agency experts from [ASI](http://www.asi.it/) (Agenzia Spaziale Italiana), [BNSC](http://www.bnsc.gov.uk/) (British National Space Centre), [CNES](http://www.cnes.fr/) (Centre National d'Etudes Spatiales) [DLR](http://www.dlr.de/) (Deutsches Zentrum fuer Luft- und Raumfahrt) and [ESA](http://www.esa.int/) (European Space Agency) drew up a Code of Conduct for space debris mitigation in 2002. The code of conduct represents a consensus between these five space agencies on what needs to be done to mitigate the proliferation of space debris. It details and complements the guidelines already being discussed at international level by the [Inter Agency Space Debris Coordination Committee](http://www.iadc-online.org/) (IADC). The IADC comprises space agencies from China, France, Germany, India, Italy, Japan, Ukraine, the UK, the USA, Russia and ESA, as well as the Scientific and Technical Subcommittee of the UN Committee on the Peaceful Use of Outer Space (UN-COPUOS). The code indicates measures to be taken during a spacecraft's operational mission and at the end of its life. The main requirements are for objects not to remain in low-Earth orbit for more than 25 years after completing their mission, and to move geostationary satellites to a graveyard orbit. Implementing such measures and codes of conduct remains controversial within the industry since their adoption as formal policy will invariably raise mission costs. However much effect is now being given to an international code of conduct, worldwide-accepted standards, and international regulations or space law to create a comprehensive framework for reducing space debris and boosting spaceflight safety.

2AC – Privatization CP

Free market solutions fail – no incentive or policy guidance.

Brower et. el., ‘8 (Jared Brower, Stephanie Cook, Edward Dale, Josh Koch, John Miller, Stephanie Silva, All researched for the Global Innovation and Strategy Center, “Eliminating Space Debris: Applied Technology and Policy Prescriptions,” Fall 2008 – Project 07-02)

Despite the claim that orbital slots will one day be owned, traded and sold in an efficient market,48 the foreseeable future remains one of universal access. The 2006 space policy of the United States “rejects any claims to sovereignty by any nation over outer space or celestial bodies...and rejects any limitations on the fundamental right of the United States to operate in and acquire data from space.”49 This precept echoes the declarations of the United Nations nearly four decades ago: “Outer space, including the moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law.”50 This “Global Common”51 of outer space offers vast opportunities for a host of government and commercial applications, while featuring a unique legal aspect, the lack of property rights. According to research on an establishment of such rights, this missing legal provision affects the orbital environment directly: By assigning property rights, a market is established in which the rights to orbital slots may be bought and sold. Selfish maximization of the profit from property rights will lead to a socially efficient outcome. The negative externalities will be eliminated.52 **Even assuming the assignment of property rights** that enable free markets to function efficiently,53 a commercialized, profit-based market for space debris elimination requires a level of active demand for mitigation that has yet to emerge. Given the current debris population, market forces have little influence over prevention or remediation outside of insurance and space policy domains. Technologies for removal are untested and launch capabilities limited and expensive. Also absent from space law is a salvage taxonomy. While orbits are free from ownership, every piece of debris from millimeter-sized paint flakes to frozen chunks of fuel remains the property of its original state or commercial owner.54 According to space lawyer Arthur M. Dula, this factor adds to the complexity of debris removal as problems might result if one country eliminated another country’s debris, even inadvertently.55 The current space policies of the United States and other space-faring nations do not portend movement towards a space property auction market in the foreseeable future. Therefore, decision-making will continue to be based on **policy guidance, rather than economics**. In this light, how can existing policies be improved to move debris elimination processes forward? What new policy tools might bring the problem of debris remediation to the global government agenda?

Classified data and legal restrictions barriers prevent effective action.

Dunstan & Szoka, ‘9 (James and Berin, “Beware Of Space Junk: Global Warming Isn’t the Only Major Environmental Problem,” Tech Liberation Front (TLF), http://techliberation.com/2009/12/18/beware-of-space-junk-global-warming-isnt-the-only-major-environmental-problem/. )

Better tracking data would be required to maximize the effectiveness of debris removal prizes. Since much of that data is classified, only a trusted intermediary could get American and Russian defense officials to work together. But the largest obstacle is legal: While maritime law encourages the cleanup of abandoned vessels as hazards to navigation, space law discourages debris remediation by failing to recognize debris as abandoned property, and making it difficult to transfer ownership of, and liability for, objects in space—even junk. By adapting maritime precedents, space law could make orbital debris removal feasible, once the right economic incentives are in place. Entrepreneurs may even find ways to recycle and reuse on orbit the nearly 2,000 metric tons of space debris, which includes ultra-high grade aerospace aluminum and other precious metals.

2AC – Privatization CP

Perm: Do Both

Public-private cooperation is key to limiting space debris.

Sénéchal, ‘7- Sloan fellow at MIT, founder of INDEVAL Switzerland, First Officer in the UN Security Council's valuation and verification of claims brought against Iraq by Kuwaiti corporations or financial institutions, holds degrees from Harvard, London Business School and Columbia (Thierry, “Space Debris Pollution: A Convention Proposal,” <http://www.pon.org/downloads/ien16.2.Senechal.pdf>)

The role of space corporations is seen as important because commercial activity in space is increasing and thus potentially creating more debris. Until recently, space debris was a subject fraught with uncertainties, usually shunned by aerospace corporations around the world and inadequately addressed by many space agencies. As the issue gained prominence in the mid1990s, the private sector has been seeking to find the most appropriate response to address the space debris problem. However, the space industry has been struggling to provide the required solutions. As competition has increased and profits have shrunk, many of the space corporations have adopted ―lean‖ approaches, the ―better, faster, cheaper‖ concept resting on the interconnection of decreased mission costs and increased risk. Most of the time, the prudent vehicle design and related operation that may decrease the level of debris is coming at a cost that is perceived too high by the industry. At a time when there is so much talk about the commercialization of space and space tourism, it is important to raise the awareness of the space industry that it is in the interest of all parties to find the best and most acceptable solution to the problem. Today, space corporations around the world are rightly considered the first line of defense for preventing debris to accumulate. As space activity increases, the accumulation of debris is also on an upward trend. Over the recent years, companies have been facing new demands to engage in public-private partnerships and are under growing pressure to be accountable not only to shareholders, but also to society-at-large. When addressing the problem posed by space debris, it is thus time to include the space industry in the international effort to tackle this pressing issue. The space industry does not bear the responsibility for leveling the playing field and ensuring that space free of pollution. However, government and the private sector must construct a new understanding of the balance of public and private responsibility and develop new governance for activity in space and thus creating social value.22

The CP fails – market forces are inefficient.

Johnson & Hudson, ‘8 (Kevin, & John, Project supervisors @ Global Innovation and Strategy Center (GISC) Internship program. “Global Innovation and Strategy Center,” <http://www.slideshare.net/stephaniclark/giscinternpaperspacedebriselimination>)

Even assuming the assignment of property rights that enable free markets to function efficiently,53 a commercialized, profit-based market for space debris elimination requires a level of active demand for mitigation that has yet to emerge. Given the current debris population, market forces have little influence over prevention or remediation outside of insurance and space policy domains. Technologies for removal are untested and launch capabilities limited and expensive. Also absent from space law is a salvage taxonomy. While orbits are free from ownership, every piece of debris from millimeter-sized paint flakes to frozen chunks of fuel remains the property of its original state or commercial owner.54 According to space lawyer Arthur M. Dula, this factor adds to the complexity of debris removal as problems might result if one country eliminated another country’s debris, even inadvertently.55 The current space policies of the United States and other space-faring nations do not portend movement toward a space property auction market in the foreseeable future. Therefore, decision-making will continue to be based on policy guidance, rather than economics. In this light, how can existing policies be improved to move debris elimination processes forward? What new policy tools might bring the problem of debris remediation to the global government agenda?

2AC – International/Treaty CP

International treaties fail- active opposition and more studies are needed

**Mirmina 05**- Senior Attorney, International Law Practice Team, Office of the General Counsel, NASA

(Steven A., “Reducing the Proliferation of Orbital Debris: Alternatives to a Legally Binding Instrument,” July, JSTOR)

The international treaty-making process can be slow and, at times, may not even result in agreement.18 The Legal Subcommittee of the Committee on the Peaceful Uses of Outer Space (COPUOS) is unlikely to agree on legally enforceable commitments with respect to orbital debris in the foreseeable future.'9 Within the subcommittee, there is no consensus in favor of concluding a treaty on orbital debris; in fact, there is active opposition to it. The primary basis for the oppo- sition has been that further work is necessary to understand the technical aspects of space debris. Yet, as described above, the problem of orbital debris continues to worsen.20 Since the international community lacks the consensus to conclude a legally binding instru- ment to address debris, one must look for a solution that is not treaty based. In March 2002, the European Centre for Space Law issued its Analysis of the Legal Aspects of Space Debris,21 in which it inquired into the additional measures that would be required to reduce space debris and the type of legal instrument that would best effect this intent.

CP Doesn’t solve – technological, political and economic difficulties

Ansdell, ‘10 (Megan, Grad Student @ George Washington University’s Elliot School of Int’l Affairs, where she focused on space policy. “Active Space Debris Removal: Needs, Implications, and Recommendations for Today’s Geopolitical Environment,” [www.princeton.edu/jpia/past-issues-1/2010/Space-Debris-Removal.pdf](http://www.princeton.edu/jpia/past-issues-1/2010/Space-Debris-Removal.pdf).

At the same time, implementing active debris removal systems poses not only difficult technical challenges, but also many political ones. The global nature of space activities implies that these systems should entail some form of international cooperation. However, international cooperation in space has rarely resulted in cost-effective or expedient solutions, especially in areas of uncertain technological feasibility. Further, it will be difficult to quickly deploy these systems before the space environment destabilizes. Problems will also arise in dividing the anticipated high costs, as a small number of countries are responsible for the large majority of the space debris population, yet all nations will benefit from its removal.

2AC – Other Country CP

US action is key--other countries don’t have the tech

Space Daily, ‘9(“Making The Space Environment Safer For Civil And Commercial Users” 5/4/09 LexisNexis)

The House Committee on Science and Technology's Subcommittee on Space and Aeronautics held a hearing to examine the challenges faced by civil and commercial space users as space traffic and space debris in Earth orbit continue to increase. Subcommittee Members questioned witnesses about potential measures to improve the information available to civil and commercial users to avoid in-space collisions and discussed ways to minimize the growth of future space debris. Ensuring the future safety of civil and commercial spacecraft and satellites is becoming a major concern. The February 2009 collision between an Iridium Satellite-owned communications satellite and a defunct Russian Cosmos satellite highlighted the growing problem of space debris and the need to minimize the chances of in-space collisions. "It was such a surprise to me and many others when we heard the news that two satellites had collided in orbit in February of this year. It was hard to believe that space had gotten that crowded. It was equally difficult to believe that nothing could have been done to prevent the collision, given that one of the satellites was active and by all accounts would have had the capability to maneuver out of harm's way," said Subcommittee Chairwoman Gabrielle Giffords (D-AZ). "I'd like to know where things stand, and what we're going to do to keep such an event from happening again." While several nations such as Russia, France, Germany and Japan have some form of space surveillance capability, these systems are not interconnected and are neither as capable nor as robust as the United States' Space Surveillance Network (SSN**).** SSN consists of a world-wide network of 29 ground-based sensors that are stated to be capable of tracking objects as small as five centimeters orbiting in Low Earth Orbit (LEO)-that is, the region of space below the altitude of 2,000 km (about 1,250 miles). For the last four years, the Department of Defense (DOD) has undertaken a Commercial and Foreign Entities (CFE) pilot program to make collision avoidance information available to commercial space users. Commercial users have found the service to be very useful and have been concerned about uncertainty concerning the CFE program's future. At the hearing, Gen. Larry James, Commander of the Joint Functional Component Command for Space, testified that the DoD would transition the CFE to an operational program later this year. Since 1957, there have been several thousand payloads launched into space. After the first fragmentation of a man-made satellite in 1961, there have been more than 190 fragmentations and 4 accidental collisions. Since January of 2007, there have been three major debris generating incidents, which have significantly increased the Earth's orbital debris environment: Iridium 33 - Cosmos 2251 Satellite Collision; Chinese A-SAT test on Fengyun-1C; and Russian spent stage explosion - Russian Arabsat 4. At this point, the DoD is tracking more than 19,000 objects in Earth orbit, and witnesses at the hearing testified that there are more than 300,000 objects of a half-inch in size or larger orbiting the Earth, with further growth in the debris population anticipated in the coming years. "One thing is already clear-the space environment is getting increasingly crowded due to the relentless growth of space debris. If the spacefaring nations of the world don't take steps to minimize the growth of space junk, we may eventually face a situation where low Earth orbit becomes a risky place to carry out civil and commercial space activities," said Giffords.

1NC Harms Frontline

1. No impact – space debris is minimal and there’s no timeframe.

Moore, ‘9 (Mike, a research fellow with the Independent Institute and a former editor of the Bulletin of the Atomic Scientists, is the author of Twilight War: The Folly of U.S. Space Dominance, published last year by the Independent Institute. “Space Debris: From Nuisance to Nightmare, FEBRUARY 12, 2009)

News reports on Feb. 12 that two satellites had collided some 491 miles above the Earth were compelling. There was a whiff of Cold War intrigue about them. A defunct Russian communications relay satellite and an American commercial satellite had met abruptly in space with a closing speed of more than 22,000 miles per hour. They were shattered into many hundreds of pieces, creating an ever expanding debris cloud. In turn, that cloud threatened the satellites of other countries in similar orbits. And yet, no one was harmed. Space is a big place, isn't it? The reports noted that there were already thousands of pieces of space junk large enough to be tracked and catalogued. Nonetheless, **no one has ever been harmed by a bit of space garbage**. At the moment, the amount of debris in low-earth orbit -- the region of space that extends a few hundred miles above the atmosphere -- is merely a nuisance. The United States tracks objects in space and shares the data with the world. Satellite handlers based in many countries use the data to slightly alter the course of their birds if a collision seems possible.

2. Zero impact from ground collisions – 1 death max

Carroll, ‘2 (Joseph A., Tether Applications, Inc., “Space Transport Development Using Orbital Debris, Final Report on NIAC Phase I Research Grant No. 07600-087, December 2, 2002)

We used the above analyses and databases to quantify risks due to random or controlled reentries from different orbits. Discussions, analyses, and manipulation of these databases in Excel and in several analytical programs we wrote in Pascal have led us to these main conclusions:

1. The risk more than scales with mass, since light objects are more likely to burn up completely. 2. Over 90% of the mass of debris in LEO is in 1,200 objects weighing >500 kg. 3. The risk per object varies by about a factor of two with orbit inclination

(Equatorial orbits have the lowest risk, and mid-inclinations have the highest risk).

Orbital debris that survives reentry transitions from mostly horizontal to mostly vertical motion about the time it decelerates below Mach 1. By the time it reaches the ground, it is likely to be falling nearly vertically. The debris impact is likely to be considerably less dangerous than a similar mass of aircraft crashing, both because of the vertical impact and because flammables are almost certain to have been burned away during reentry. However, reentry of objects containing large amounts of radioactive material may cause more serious problems.

If we assume that the “lethal impact area” on the ground is of order 20m2 per ton of original satellite mass, then the lethal impact area on the ground from all ~2000 tons of LEO orbital debris is about 40,000 m2. The average human population density of the earth (land and sea, all latitudes) is about 1 person per 80,000 m2. The exact numbers in this rough analysis are subject to dispute, and to refinement due to covariation of population density and reentry patterns, but it seems reasonable to say that random reentry of all debris now in low earth orbit is more likely to result in either 0 or 1 human fatalities than a larger number.

Blackouts NBD

Increased government regulation means that blackouts are much less likely

New York Times, ‘8 (Ken Belson and Matthew L. Wald, “’03 Blackout Is Recalled, Amid Lessons Learned”, August 13, <http://www.nytimes.com/2008/08/14/nyregion/14blackout.html?_r=1&oref=slogin>)

After the blackout, regulation increased. The National Energy Policy Act of 2005 was designed to prevent problems on shaky networks from affecting neighboring grids. Voluntary standards for maintaining reliable service were made mandatory. The [Federal Energy Regulatory Commission](http://topics.nytimes.com/top/reference/timestopics/organizations/f/federal_energy_regulatory_commission/index.html?inline=nyt-org) strengthened the penalties for utilities and power producers that did not meet the tougher guidelines. “I can confidently say that the events that led to the 2003 blackout are now much less likely to occur,” said Rick Sergel, president of the North American Electric Reliability Corporation, a nonprofit industry group. But Mr. Sergel stopped well short of saying a repeat was impossible — because there are many variables in a network that vast. The National Energy Policy Act included about 100 requirements, including rules for trimming trees. This year, Baltimore Gas & Electric and the MidAmerican Energy Company were ordered to pay $225,000 for failing to keep their trees trimmed. Before the standards became mandatory, grid operators were asked whether they were in compliance with recommended standards, and they generally answered yes. Now, utilities in New York and elsewhere audit their neighbors to find flaws. Another big change is the improvement of devices on the grid called relays, which resemble circuit breakers and take power lines, transformers and power plants out of service if they sense something wrong. At the time of the blackout, many of these relays were too sensitive and confused high power flows with short circuits. So when the failures began, networks were unnecessarily shut down, contributing to the cascade. “The transition to a mandatory reliability entity was a pretty big deal,” said Lawrence J. Makovich, a senior advisor at Cambridge Energy Research Associates. “It’s hard to make important changes to something you take for granted. The blackout did cause some major change that might not have happened otherwise.” Mr. Makovich added that since the blackout of 2003, electric companies have added transmission lines and other critical parts of the network to make up for years of underinvestment.These extra steps, said William Longhi, senior vice president of central operations at Con Edison, mean that New York City is less likely to suffer as a result of problems elsewhere. “The grid itself is incredibly complicated,” he said, and because humans are involved, “there’s always a possibility of an event again. But we’re confident that with all the measures taken across America, that certainly the event itself, if it were replayed, would have a completely different ending to it.”

Blackouts have no lasting effect on the American economy

CBS Marketwatch, ‘3 (Greg Robb, “Economy to shrug off blackout”, August 16, http://www.marketwatch.com/news/story/blackout-impact-economy-big-snowstorm/story.aspx?guid=%7B12B5DD14-9251-43E7-B163-5128DD06F3CC%7D)

It's hard to think of a snowstorm in August, but that's the best way to understand the impact on the economy of the blackouts in the Northeastern region of North America, economists said. "The economic impact is almost immeasurable. The economics are similar to those of a snowstorm," said Mark Zandi, chief economist at Economy.com. "It is a nuisance -- it delays economic activity but ultimately that activity is made up in subsequent days and weeks," Zandi added. Brian Wesbury, chief economist at Griffin, Kubik, Stephens & Thomson in Chicago, agreed: "It shuts down activity, people change their behavior, but everything comes back to normal."

Warming NBD

1. Warming is irreversible – satellites are worthless.

Solomon, ‘9 (Susan, National Oceanic and Atmospheric Administration, member of the US National Academy of Sciences, the European Academy of Sciences, and the Academy of Sciences of France, Nobel Peace Prize Winner, Chairman of the IPCC, February 10, “Irreversible climate change due to carbon dioxide emissions” PNAS, Vol 106, <http://www.pnas.org/content/early/2009/01/28/0812721106.full.pdf>)

Over the 20th century, the atmospheric concentrations of key greenhouse gases increased due to human activities. The stated objective (Article 2) of the United Nations Framework Convention on Climate Change (UNFCCC) is to achieve stabilization of greenhouse gas concentrations in the atmosphere at a low enough level to prevent ‘‘dangerous anthropogenic interference with the climate system.’’ Many studies have focused on projections of possible 21st century dangers (1–3). However, the principles (Article 3) of the UNFCCC specifically emphasize ‘‘threats of serious or irreversible damage,’’ underscoring the importance of the longer term. While some irreversible climate changes such as ice sheet collapse are possible but highly uncertain (1, 4), others can now be identified with greater confidence, and examples among the latter are presented in this paper. It is not generally appreciated that the atmospheric temperature increases caused by rising carbon dioxide concentrations are not expected to decrease significantly even if carbon emissions were to completely cease (5–7) (see Fig. 1). Future carbon dioxide emissions in the 21st century will hence lead to adverse climate changes on both short and long time scales that would be essentially irreversible (where irreversible is defined here as a time scale exceeding the end of the millennium in year 3000; note that we do not consider geo-engineering measures that might be able to remove gases already in the atmosphere or to introduce active cooling to counteract warming). For the same reason, the physical climate changes that are due to anthropogenic carbon dioxide already in the atmosphere today are expected to be largely irreversible. Such climate changes will lead to a range of damaging impacts in different regions and sectors, some of which occur promptly in association with warming, while others build up under sustained warming because of the time lags of the processes involved. Here we illustrate 2 such aspects of the irreversibly altered world that should be expected. These aspects are among reasons for concern but are not comprehensive; other possible climate impacts include Arctic sea ice retreat, increases in heavy rainfall and flooding, permafrost melt, loss of glaciers and snowpack with attendant changes in water supply, increased intensity of hurricanes, etc. A complete climate impacts review is presented elsewhere (8) and is beyond the scope of this paper. We focus on illustrative adverse and irreversible climate impacts for which 3 criteria are met: (i) observed changes are already occurring and there is evidence for anthropogenic contributions to these changes, (ii) the phenomenon is based upon physical principles thought to be well understood, and (iii) projections are available and are broadly robust across models.

2. No impact to warming

Singer, ‘7 (Fred, an atmospheric physicist, is Research Fellow at the Independent Institute, Professor Emeritus of Environmental Sciences at the University of Virginia, and former founding Director of the U.S. Weather Satellite Service “The Great Global Warming Swindle”, The Independent Institute, May 22nd, http://www.independent.org/newsroom/article.asp?id=1945)

3. Finally, no one can show that a warmer climate would produce negative impacts overall. The much–feared rise in sea levels does not seem to depend on short–term temperature changes, as the rate of sea–level increases has been steady since the last ice age, 10,000 years ago. In fact, many economists argue that the opposite is more likely—that warming produces a net benefit, that it increases incomes and standards of living. Why do we assume that the present climate is the optimum? Surely, the chance of this must be vanishingly small, and the economic history of past climate warmings bear this out. But the main message of The Great Global Warming Swindle is much broader. Why should we devote our scarce resources to what is essentially a non–problem, and ignore the real problems the world faces: hunger, disease, denial of human rights—not to mention the threats of terrorism and nuclear wars? And are we really prepared to deal with natural disasters; pandemics that can wipe out most of the human race, or even the impact of an asteroid, such as the one that wiped out the dinosaurs? Yet politicians and the elites throughout much of the world prefer to squander our limited resources to fashionable issues, rather than concentrate on real problems. Just consider the scary predictions emanating from supposedly responsible world figures: the chief scientist of Great Britain tells us that unless we insulate our houses and use more efficient light bulbs, the Antarctic will be the only habitable continent by 2100, with a few surviving breeding couples propagating the human race. Seriously!

1NC Solvency Frontline

1. No technology and it’s cost prohibitive.

David, ‘11 (Leonard David has been reporting on the space industry for more than five decades. He is a winner of this year’s National Space Club Press Award and a past editor-in-chief of the National Space Society's Ad Astra and Space World magazines. “Ugly Truth of Space Junk: Orbital Debris Problem to Triple by 2030, 09 May 2011, http://www.space.com/11607-space-junk-rising-orbital-debris-levels-2030.html)

Complex and very expensive "The buildup of debris is not a naturally reversible process. If we are to clean up space, it will certainly be complex and very expensive. If we continue, as we have, to use these very popular orbits in near-Earth space, the density of debris and collision events will surely increase," Kaplan told SPACE.com. The good news is that no immediate action is necessary in terms of removing debris objects, Kaplan advised, as experts estimate that the situation will not go unstable anytime soon. "But, when it does, operational satellites will be destroyed at an alarming rate, and they cannot be replaced. We must prepare for this seemingly inevitable event," Kaplan said. While there are many options for debris removal that have been proposed, he feels that none are sensible. "Barring the discovery of a disruptive technology within the next decade or so, there will be no practical removal solution," Kaplan added. "We simply lack the technology to economically clean up space." [Lasers Could Zap Space Junk Clear From Satellites] For Kaplan, the issue of dealing with orbital debris will become dire. "The proliferation is irreversible. Any cleanup would be too expensive. Given this insight, it is unlikely spacefaring nations are going to do anything significant about cleaning up space," Kaplan said. "The fact is that we really can't do anything. We can't afford it. We don't have the technology. We don't have the cooperation. Nobody wants to pay for it. Space debris cleanup is a 'growth industry,' but there are no customers. In addition, it is politically untenable."

2. Market forces solve the aff – when the risk if high enough, people will take action. No need for the plan now.

Baiocchi, '10 (Dave, William Welser IV, "Confronting Space Debris” RAND, National Defense Research Council, Prepared for the Defense Advanced Research Projects Agency Approved for public release)

When viewed in light of the comparable problems, there is evidence to suggest that orbital debris does not pose a great enough risk to warrant the deployment of a remediation technology.1 Currently, the space community appears unwilling to invest in such a venture. As we suggested in Chapter Five, a community will only move on to the next stage when the risk of the status quo comes to be viewed as unacceptably high. While everyone in the space community certainly agrees that orbital debris poses a risk, the lack of government and pri- vate industry funding for this effort suggests that the risk has not yet crossed a critical threshold. Obviously, in the event that a collision with debris destroyed a valuable space asset, the risk calculus would sud- denly change in favor of deploying a remedy immediately. The current lack of private (nongovernment) funding toward debris remedies is particularly telling. Today, the majority ownership of operational space assets (as a percentage of the total operational population) has shifted from government to commercial industry.2 For this new majority of commercial stakeholders, “the imperative to create shareholder value entails that any investment in a technical system be guided by its value creation potential” (Brathwaite and Saleh, 2009). In other words, if debris was deemed to represent an unacceptable risk to current or future operations, a remedy would already have been devel- oped by the private sector. One interesting way to quantify the community’s risk appears to be currently under way. At a joint NASA/DARPA meeting on orbital debris in December 2009, the Department of Space Technology (SpaceTech) of the Delft University of Technology in the Netherlands distributed a survey with questions specifically designed to gauge the current risk climate.3 It will be particularly interesting to review the results of this survey because it may serve as an indication of whether the community feels that a remedy is currently necessary.

Politics Link

Debris removal is political suicide – it’s expensive and no one wants responsibility.

David, ‘11 (Leonard David has been reporting on the space industry for more than five decades. He is a winner of this year’s National Space Club Press Award and a past editor-in-chief of the National Space Society's Ad Astra and Space World magazines. “Ugly Truth of Space Junk: Orbital Debris Problem to Triple by 2030, 09 May 2011, http://www.space.com/11607-space-junk-rising-orbital-debris-levels-2030.html)

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Market CP

Text: The X-PRIZE Foundation should offer a substantial financial award to entities that create and deploy effective space debris solutions.

The CP solves the case – it sparks innovation and low costs solutions to space debris and independently leads to prevention across the industry.

Brower et. el., ‘8 (Jared Brower, Stephanie Cook, Edward Dale, Josh Koch, John Miller, Stephanie Silva, All researched for the Global Innovation and Strategy Center, “Eliminating Space Debris: Applied Technology and Policy Prescriptions,” Fall 2008 – Project 07-02)

Creating a Market for Space Debris Elimination Today there are thousands of markets that cater to a variety of subjects and demographics but all markets have one thing in common in that they connect co- dependent organizations and individuals. This interdependence is the lifeline of the market. This interdependence is typically in the form of consumer/producer or demander/supplier relationships. The two ideas presented in this section, X-PRIZE and Seeding a Business Cycle, use the market concept for the elimination of space debris. X-PRIZE The X-PRIZE is a world-wide cash prize that rewards technological innovations. In the automotive, space, and many other fields the X-PRIZE touches a wide range of technologies. In the words of X-PRIZE founder and CEO, Peter Diamandis, “the prize galvanizes huge amounts of global interest.”86 Creating global interest and spreading an entrepreneurial mentality have the potential to spark the formation of a competitive market that can create inexpensive and innovative solutions. This “model” might provide an avenue for renewed interest and/or innovation. Public “prize” model topics come from many different sources. If an industry is “stuck” due to high technology costs or the lack of technology or if someone wants to see if a particular task can be completed, this “prize” approach may be the right way to stimulate directed efforts. From launching costs to space assets, there is nothing inexpensive about space technology. As a solution to funding the technology development needed to eliminate space debris, the global interest generation concept demonstrated by a “prize” model might be effective. Global interest has the potential to not only spark inexpensive and innovative elimination technologies but are also an opportunity to create global awareness. Awareness could lead to improved prevention techniques and help reduce future debris numbers.

Aerogel CP

Text: The United States federal government should substantially expand the use of Aerogel to remove and mitigate small space debris objects orbiting beyond the Earth’s mesosphere.

Solvency better than lasers – sustains impact and captures small debris

Burchell, ‘6 – PHD in planetary physics (Mark J. Burchell, May 2006, COSMIC DUST COLLECTION IN AEROGEL, Vol. 34: 385-418, pg 406)

Aerogel has now been used for almost two decades to capture particles at high speed. It has been extensively deployed in space, and suitable extraction and analysis techniques have been developed for the captured cosmic dust. The return of the Stardust cometary dust samples in 2006 will undoubtedly trigger a major burst of interest in capture of dust in aerogel. For most researchers, the aerogel will be of no interest, it is study of the dust that is the real scientific goal. Based on the work reviewed above, such researchers can have confidence that a sufficient understanding of aerogel and its use as a capture medium has been obtained. Analysis techniques (a range of which have been outlined here) are sufficiently developed and tested to permit the detailed study of captured dust. Aerogel capture cells can thus be considered to have reached maturity as a scientific method for the study of cosmic dust. The dust extracted from aerogel contains unaltered samples of the original grains (if the original particle was sufficiently robust). These are, in general, far superior to the residues (found in impact craters) currently used to analyze cosmic dust. The sizes and volumes will be in nanograms, but for current analysis techniques this is not an issue. Although some analysis can be applied in situ, more detailed analysis requires that the particle either be exposed on a cut aerogel surface or completely extracted. This can then permit a precise mineral composition involving interelement stoichiometric ratios. For analysis of volatile and organic components, there may be difficulties related to heating and contamination during the capture process that limit the precision of any subsequent analysis. Nevertheless, some organic analysis is possible, as described above. One difficulty with capture in aerogel lies in the treatment of submicron grains. It is not clear how these can be found optically (although the larger tracks may be visible at the micron scale, the captured particle will not be). Nor is it clear how these could be found by any other spectroscopic analysis technique. This may well set a lower limit to the size of particles that can be studied after capture in aerogel. Overall, aerogel offers a readily usable medium for capturing cosmic dust in space. The next decade will see more use of it and a growing volume of scientific results based on captured cosmic dust.

Aerogel Solvency

Aerogel is testing and is extremely effective in capturing small, high speed space debris particles – tested and works really well

Burchell, ‘6 – PHD in planetary physics (Mark J. Burchell, May 2006, COSMIC DUST COLLECTION IN AEROGEL, Vol. 34: 385-418, pg 406)

The classic particle capture in aerogel at high speed produces a carrot-shaped track near the end of which is found a relatively intact particle (Figures 2 and 3). The track can easily be seen in the transparent aerogel. It has an entrance hole (Figure 4) that is larger than the cross-sectional area of the particle. Beyond the entrance, the track quickly widens by approximately 50% and then slowly tapers along its length until it is the particle size. The track is typically in line with the impact direction until near its end, where the particle may deviate significantly from this direction. The captured particle may have acquired a partial wrap of molten aerogel during its capture. When considering the use of aerogel as a capture medium for particles in space, the impact speed is important. In LEO, the typical impact speed of man-made debris is in the range of 7 to 11 km s−1 and is typically 20 to 25 km s−1 for dust from interplanetary space. Indeed, if the dust is interstellar or from a prograde long-period comet, it can be as high as 60 to 70 km s−1. Specific impact speeds may be determined for particular space missions. For example, the NASA Stardust mission has used aerogel to capture cometary dust at 6.1 km s−1 (see below). Unfortunately, not all these speeds are achievable in laboratory experiments at the required particle sizes. The two main techniques for particle acceleration are (a) the two-stage light gas gun and (b) the Van de Graaff accelerator. The former can only achieve speeds of 8 to 10 km s−1 at most, but can do so for millimeter-sized particles. The latter can achieve speeds of up to 100 km s−1 but only for submicron-sized dust grains. Indeed, in a Van de Graaff dust accelerator, particle size and speed are inversely correlated (e.g., see Burchell et al. 1999a); a 1 micron particle is typically accelerated to 3 to 5 km s−1, and it is the smaller, submicron particles that are accelerated to higher speeds. Unless stated otherwise, the experiments described herein were performed with light gas guns. The first report of successful capture of high-speed particles in aerogel under controlled conditions was by Tsou et al. (1988), with aerogel of density 150 kg m−3 and glass beads fired into it at a speed of 5.13 km s−1. They found clear tracks and captured particles in the aerogel**.** Glass beads of 50 μm diameter left tracks approximately 1.5 mm long. They also found observable tracks from particles as small as 10 μm. In a second paper (Tsou et al. 1989), the same group showed that a 1.6-mm-diameter aluminum sphere could be captured relatively intact in aerogel of density 50 kg m−3. The track length was given as of order 20 cm and at 5–6 km s−1, only some 60% of the original particle's mass was recovered in a single object at the end of the track.

Aerogel has been tested many times and is highly successful in capturing large and small pieces of debris.

Burchell, ‘6 – PHD in planetary physics (Mark J. Burchell, May 2006, COSMIC DUST COLLECTION IN AEROGEL, Vol. 34: 385-418, pg 406)

Even before it had been demonstrated that aerogel could capture particles in high-speed impacts, aerogel dust collectors were already deployed in space. Initially flown on the space shuttle several times, aerogel collectors were then flown on a retrievable satellite (EuReCa), on the outside of the Mir space station (several times) on missions into interplanetary space (Stardust) and on the outside of the ISS. The first use of aerogel in space was on space shuttle flights STS 41-B, STS 41-D, and STS-61B in 1984/85 (Maag & Kelly Linder 1992). A common particle capture experiment **(**consisting of organic foams, aerogel, and kapton foil)was used. The aerogel in STS 61-B captured an aluminum oxide sphere (probably from the exhaust of a solid rocket motor). Later (in 1992) STS-47 also carried aerogel capture cells (density 20 kg m−3). After 170 h exposure time, the aerogel was examined on Earth and found to contain four hypervelocity impact tracks (Tsou et al. 1993). Although only an optical analysis was carried out, based on the characteristics of the tracks and particles, three of the four were tentatively identified as silicate in origin, with the fourth as man-made space debris. This is thus probably the first successful capture of extraterrestrial dust in aerogel in space. Similar cells were also flown on STS-57, STS-60, STS-64, and STS-68 (Tsou 1995). This was then followed by deployment of an aerogel collector on the European Space Agency's retrievable satellite EuReCa. The Ticce experiment contained four aerogel trays (0.04 m2 of 50 kg m−3 aerogel) and was exposed in space for 11 months. Analysis on the ground revealed 10 tracks and two bowl-shaped pits in the aerogel (Brownlee et al. 1994). Subsequent discussion of the impact conditions indicated a likely source for the extraterrestrial particles to be micrometeoroids with retrograde trajectories (Burchell et al. 1999b). Several experiments on the exterior of the Mir space station involved deployment of aerogel dust collectors. The Euro Mir '95 experiment was exposed from October 1995 to February 1996. Examination of its two aerogel (density 100 kg m−3) collectors back on Earth offers a cautionary tale (Shrine et al. 1997). One aerogel sample had broken up, apparently owing to a mechanical shock either from handling during retrieval or handling on the ground. The other showed no sign of impacts of particles (lower size limit microns), and flux models subsequently predicted only two such impacts were likely during its exposure. This illustrates that the brittle nature of aerogel requires special handling procedures and that exposures of short times or small surface area(i.e., a low area:time product relative to the expected flux)are of limited value**.** More successful was the deployment of 0.63 m2 of aerogel (20 kg m−3) on the exterior of Mir for 18 months as part of the Orbital Debris Collector (ODC) in 1996–1997 (Hörz et al. 2000). Hundreds of impacts were found during the subsequent analysis, some of which featured in-clusters (where it was assumed a primary impact on a nearby surface of Mir produced a swarm of secondary ejecta which then impacted the aerogel). Based on their depth (t) to diameter (D) ratios, the impact features were classified as tracks (t/D > 10), pits (0.5 < t/D < 10), or shallow depressions (t/D < 0.5). The pits were not analogous to any laboratory impacts and were held to arise from ultra-fast impacts. They contained no identifiable captured particle and little in the way of impact residues.

International CP Solvency

International CP

Brower et. el., ‘8 (Jared Brower, Stephanie Cook, Edward Dale, Josh Koch, John Miller, Stephanie Silva, All researched for the Global Innovation and Strategy Center, “Eliminating Space Debris: Applied Technology and Policy Prescriptions,” Fall 2008 – Project 07-02)

Existing Treaty Options: Outer Space Treaty of 1967

The International Convention on Liability for Damage Caused by Space Objects has not been invoked with any significance to date despite a number of debris-causing events within the last ten years or so. One reason for this may be due to the absence of an enforcement body specific to outer space law. The International Court of Justice (ICJ), the judicial branch of the U.N., hears territorial and maritime disputes at the request of member states. As a U.N. judicial body, the ICJ is likely to one day review a space liability dispute. In the absence of strict enforcement and in the event of a major space debris incident, space-faring nations are likely to rely on collective pressure or bilateral negotiations to recover damages from the launching country. The Outer Space Treaty of 1967, the Convention on International Liability for Damage Caused by Space Objects of 1973, the Registration Convention of 1976, the Agreement on the Rescue of Astronauts, and the Moon Agreement of 1979 are inconsistent in the use of terminology. Clarification of terminology will diminish the likelihood that countries new to space exploration will misinterpret Outer Space Treaty principles, guidelines, and norms, including those found within space debris mitigation guidelines.

Prefer the CP – An international agreement is a perquisite to solve.

Schumacher, ’10 (Cindy, “Conference Explores Space Debris Threats and Solutions,” January 21, 2010 <http://www.mauiweekly.com/page/content.detail/id/500916/Conference-Explores-Space-Debris-Threats-and-Solutions.html?nav=13>)

The basic problem is that even if we stopped flying anything into orbit, the debris population would continue to increase because collisions between existing space objects will continue. In order to control the growth of space debris, it is necessary to remove some space objects to reduce the number of future collisions. Legal and insurance representatives at the conference also raised some difficult issues. Any debris removal system will have to contend with legal and policy issues, said the representatives. Nations and companies retain ownership of hardware in orbit after it is retired, so an international agreement or legislation may be required before someone else is allowed to remove it, they said.

Voluntary agreements can work – even without enforcement.

Brower et. el., ‘8 (Jared Brower, Stephanie Cook, Edward Dale, Josh Koch, John Miller, Stephanie Silva, All researched for the Global Innovation and Strategy Center, “Eliminating Space Debris: Applied Technology and Policy Prescriptions,” Fall 2008 – Project 07-02)

NASA legal counsel Steven A. Mirmina wrote a journal article for *The American Journal of International Law* titled “Reducing the Proliferation of Orbital Debris: Alternatives to a Legally Binding Instrument.”81 In the article, Mirmina asserts that voluntary agreements are effective and serve as an important alternative to legally binding agreements. Mirmina describes how various countries came together to address the growing concern over the continued proliferation of weapons of mass destruction. Partner members of the Missile Technology Control Regime (MTCR) Agreement, an agreement dedicated to the prevention of continuing proliferation of weapons of mass destruction, initiated guidelines82to be followed voluntarily by MTCR partner countries. The agreement is a living document in that it is open to revision as technology advances. The Wassenaar Agreement is an export controls agreement for conventional arms and dual use technologies. Some 40 member countries adhere to the agreement despite maintaining individual export controls. One of the reasons a voluntary agreement would work has to do with national sovereignty. If, as with the Wassenaar Agreement, individual nations are left to regulate themselves and yet remain responsible to a collective reporting mechanism that fosters transparency, the nation state is more likely to participate. There are other means by which to hold a state responsible for damages caused by errant satellites at the end of its orbital life. The Liability Convention entered into as of September 1972 under U.N. auspices holds the “launching state” of a satellite responsible for damages caused by the satellite.

Code of Conduct CP Solvency

There are code of conduct provisions for space debris.

International Astronautical Federation, ‘8 (Space Debris, <http://www.iafastro.net/index.php?id=558>)

A group of space agency experts from [ASI](http://www.asi.it/) (Agenzia Spaziale Italiana), [BNSC](http://www.bnsc.gov.uk/) (British National Space Centre), [CNES](http://www.cnes.fr/) (Centre National d'Etudes Spatiales) [DLR](http://www.dlr.de/) (Deutsches Zentrum fuer Luft- und Raumfahrt) and [ESA](http://www.esa.int/) (European Space Agency) drew up a Code of Conduct for space debris mitigation in 2002. The code of conduct represents a consensus between these five space agencies on what needs to be done to mitigate the proliferation of space debris. It details and complements the guidelines already being discussed at international level by the [Inter Agency Space Debris Coordination Committee](http://www.iadc-online.org/) (IADC). The IADC comprises space agencies from China, France, Germany, India, Italy, Japan, Ukraine, the UK, the USA, Russia and ESA, as well as the Scientific and Technical Subcommittee of the UN Committee on the Peaceful Use of Outer Space (UN-COPUOS).

The code indicates measures to be taken during a spacecraft's operational mission and at the end of its life. The main requirements are for objects not to remain in low-Earth orbit for more than 25 years after completing their mission, and to move geostationary satellites to a graveyard orbit. Implementing such measures and codes of conduct remains controversial within the industry since their adoption as formal policy will invariably raise mission costs. However much effect is now being given to an international code of conduct, worldwide-accepted standards, and international regulations or space law to create a comprehensive framework for reducing space debris and boosting spaceflight safety.

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AESTROPOLITICS JOURNAL!!!

<http://www.philforhumanity.com/Space_Debris.html>

Proposals have been made for ways to "sweep" existing space debris back into Earth's atmosphere, including automated tugs, laser brooms to vapourise or nudge particles into rapidly-decaying orbits, or huge aerogel blobs to absorb impacting junk and eventually fall out of orbit with them trapped inside. These methods would be hugely expensive, even if feasable, and somebody would need to provide the finance.

Tether

<https://www.afresearch.org/skins/rims/q_mod_be0e99f3-fc56-4ccb-8dfe-670c0822a153/q_act_downloadpaper/q_obj_ebe8b7d6-fd6b-4522-8615-c350adc97d87/display.aspx?rs=enginespage>)

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Laser

<http://www.spacefuture.com/archive/orions_laser_hunting_space_debris.shtml>

<http://www.physorg.com/news/2011-03-nasa-laser-space-junk.html>

Source to research

Delbert Smith suggests that several market approaches might be used to discourage debris creation, including debris damage exclusions and premium increases.144 Cynamon posits the provision of tax incentives to insurance companies who encourage responsible satellite construction through underwriting procedures, “analogous to the savings automobile insurers provide for air bags or alarms.”145